A1250-1

JUNE 24, 1991

CHEMICAL & ENGINEERING

NEWS

& Figures

...stry

**********5-DIGIT 20814
05111790091 P K AR6925SL01 0142
CONGRESSIONAL INFO SERV-SRI
SRI ACQUISITIONS
4520 EAST WEST HWY SUITE 800
BETHESDA MD 20814-3389

CHEMICAL & ENGINEERING
NEWS
Volume 69, Number 25
CENEAR 69 (25) 1–96
ISSN 0009-2347
JUNE 24, 1991

News of the Week

■ **Explosion, fire at Albright & Wilson Americas' phosphorus chemicals plant in Charleston, S.C., kills six.** **Page 4**

■ **International conference on AIDS offers encouraging news on the growing understanding of HIV's molecular biology, but grim numbers on worldwide HIV infections.** **Page 5**

■ **Triennial plastics show in Chicago sets record for number of exhibitors, gives indications that recession's effects on the industry may be bottoming out.** **Page 5**

■ **Leading Democratic Senators offer bills designed to boost U.S. competitiveness in critical technologies, advanced manufacturing areas.** **Page 6**

■ **Illinois court reverses jury decision in TCDD case that called for Monsanto to pay $16.25 million in punitive damages.** **Page 6**

Cover: Photo courtesy of Goodyear

Letters 2

Concentrates
Business 7
Government 17
Science/Technology 20

The Departments
New Products 70
ACS News 84
Awards 85
Newscripts 96

Business

CMA's policy statement on North American Free Trade Agreement emphasizes feedstock, environment, market access, foreign investment. **Page 9**

Jacobs Engineering Group expands East Coast operations for process plant design, construction, and maintenance. **Page 11**

Government

High-technology materials companies need changes in antitrust laws, financial incentives, and other government help to maintain competitiveness, industry leaders tell House hearing. **Page 18**

U.S. pesticide producers are criticized for exporting unregistered or banned pesticides that, in turn, are used on food crops imported into the U.S. **Page 19**

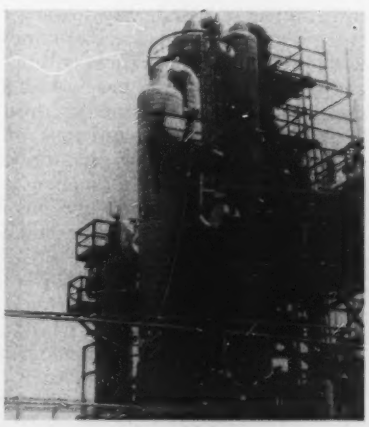
Science/Technology

Scientists' first look at zeolite cavity's reaction kinetics reveals why it so effectively catalyzes a simple substitution reaction. **Page 21**

Attempts to assess effects of supersonic jets on Earth's ozone layer raise questions about role of heterogeneous reactions. **Page 23**

Books

Competing views on multiple chemical sensitivity, a growing problem, are explored in new book. **Page 82**



Facts & Figures

Although sales and production continued to climb for chemical producers in 1990, profits declined sharply as the expansion of the late 1980s came to an end. C&EN's annual statistical wrapup details recent results in the U.S. and abroad. **Page 28**

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
Editor: Michael Heylin
Assistant Managing Editors: James H. Krieger, Janice R. Long, Donald J. Soisson, William J. Storck
Staff Editor: Ernest L. Carpenter
Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; London: Patricia L. Layman; Washington: Doron Dagani, Lois R. Ember, Bette Hileman, Wilbert C. Lepkowski, Rebecca L. Rawls, Pamela S. Zurer
Associate Editors: Stuart A. Borman, Mairin B. Brennan, Ann Marie Menting, Richard J. Seltzer
Service Departments Editor: Dolores Miner
Editing Services: Arlene Goldberg-Gist (Head), Rita E. Johnson (Editorial Assistant), Patricia Oates (Administrative Assistant)
News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Associate Editor), Ann M. Thayer (Associate Editor), Rachel Eskenazi (Administrative Assistant). Chicago: (708) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head), Susan J. Ainsworth, (Associate Editor). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head)
Graphics and Production: Leroy Corcoran (Head). Barbara Fryer (Art Director). Linda Mattingly (Staff Artist). Diane Kelly (Costing)
Composition Systems Administrator: Vincent L. Parker. **Assistant:** Robin L. Shapiro
Business Manager: Arthur Poulos
Circulation Director: David Schulbaum
ADVISORY BOARD: Dexter F. Baker, George M. Bodner, F. Peter Boer, Will D. Carpenter, Renée G. Ford, Ethan C. Galloway, Louis J. Glunz, Kenneth G. Hancock, Harry S. Hertz, Christopher T. Hill, Kendall N. Houk, Cynthia A. Maryanoff, Linda B. McGown, C. Bradley Moore, George B. Rathmann, David A. Shirley, Peter H. Spitz, Barry M. Trost

Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-4432
John Kistler Crum, Executive Director
Robert H. Marks, Director, Publications Division

PUBLISHING BOARD: Jean'ne M. Shreeve *(Chairman); Board of Directors Chairman:* Joseph A. Dixon; *President:* S. Allen Heininger; Richard L. Deming; William P. Jencks; Gary J. Long; and Louis D. Quin

© Copyright 1991, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: ACS, Dept. L-0011, Columbus, Ohio 43268-0011. Correspondence and telephone calls for changes of address, claims for missing issues, subscription orders, status of records and accounts should be directed to: Manager, Member & Subscriber Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (800) 333-9511 or (614) 447-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign; more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1991: Printed editions: nonmembers U.S. 1 yr. $95, 2 yr. $171; outside U.S. 1 yr. $131, 2 yr. $243. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $12. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management: CENTCOM LTD.
(For list of offices see page 96)
Office of Ombudsman: (800) ACS-5558, No. 8

LETTERS

Effects of agent orange

There was a report (C&EN, April 15, page 12) on the results of two recent government studies of the effects of agent orange on Vietnam veterans.

C&EN's analysis of the two reports is misleading. The first report about 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) levels of personnel who participated in Operation Ranch Hand is only a small percentage of the original study group: 866 out of 1242. If one half of the 866 subjects were pilots and copilots, then only 50% of the group (console operators and handlers) were heavily exposed to the herbicides. A poor exposure index and too few study subjects do not lead to statistically significant consequences.

The second part of the article generalizes the results of the Department of Veterans Affairs adipose tissue study of deceased veterans. All 36 subjects are reported to be Vietnam veterans. Eight served off-shore and two arrived in Vietnam long after the spraying ceased. Tissues were drawn from an unrepresented sample of data.

Had operational analysis techniques been applied when conducting the studies, the differences in the disease rates would have been more clear to the public. The report about the two studies is not representative of the total Vietnam veteran population.

Richard S. Christian
Deputy Director for Research & Technology Assessment, Veterans Affairs & Rehabilitation, The American Legion
Washington, D.C.

Future chemistry perspectives

The chemist, an extraordinary breed of scientist, educator, and researcher, has contributed tremendously toward the enhancement of living standards and toward technological advances within the past 100 years. One can hardly find any area of science and technology, health, agriculture and food, alternative energies, manufacture of new products with the preservation of environmental quality in mind, and so forth, that has not been affected by the very important role of chemists.

Such contributions have not, frankly, been fully recognized both in terms of monetary compensation and public image and acknowledgment. It is about time that we, through ACS, take a clearer and more effective stand on these two very important issues. The average number of years of graduate studies beyond a bachelor's degree for a chemistry Ph.D. and an M.D. degree is six and four years, respectively. One could hardly find a doctoral chemistry graduate without having had at least a couple of quality original scientific articles. Nevertheless, everybody knows of the differences in financial compensation and public image that the physicians have achieved.

At the global level, we are entering an era when society at large should and will realize that its most vital treasure is its intellectual resources. I believe we, within ACS, should work in a concerted fashion to bring about similar fruits to our fellow colleagues. This should, in turn, help the chemist shortage beyond the year 2000. It is projected that by the year 2000, we as a nation could suffer a shortfall of as many as over half a million science and engineering professionals if serious measures are not taken now. One of the most critical issues is surely who will replace the currently active scientific community in the years ahead. Many studies indicate that by the year 2000, over three quarters of the net new entrants into the job market will be women and minorities. So we should continue defining our positions and plans to look at providing opportunities and challenges for this majority of our new work force.

This, the other main issue, is to promote the recruitment and retention of native U.S. chemistry students at various academic levels. I believe the federal and state governments, private and corporate sectors, and the entire system of education—all in partnership—should work together in order to excite, attract, and retain a substantially higher number of students to the science and engineering disciplines in general and chemistry in particular. Industry should further continue participating in this endeavor by developing open houses for students at all levels, offering presentations to educational

Correction

• June 17, page 70: In the agenda for the Committee on Constitution & Bylaws listed in the preliminary program for the combined chemical congress and ACS national meeting in August, urgent action is requested on the dues escalator provisions received on 5/8/91, not the provisions received on 12/26/90.

Facts & Figures

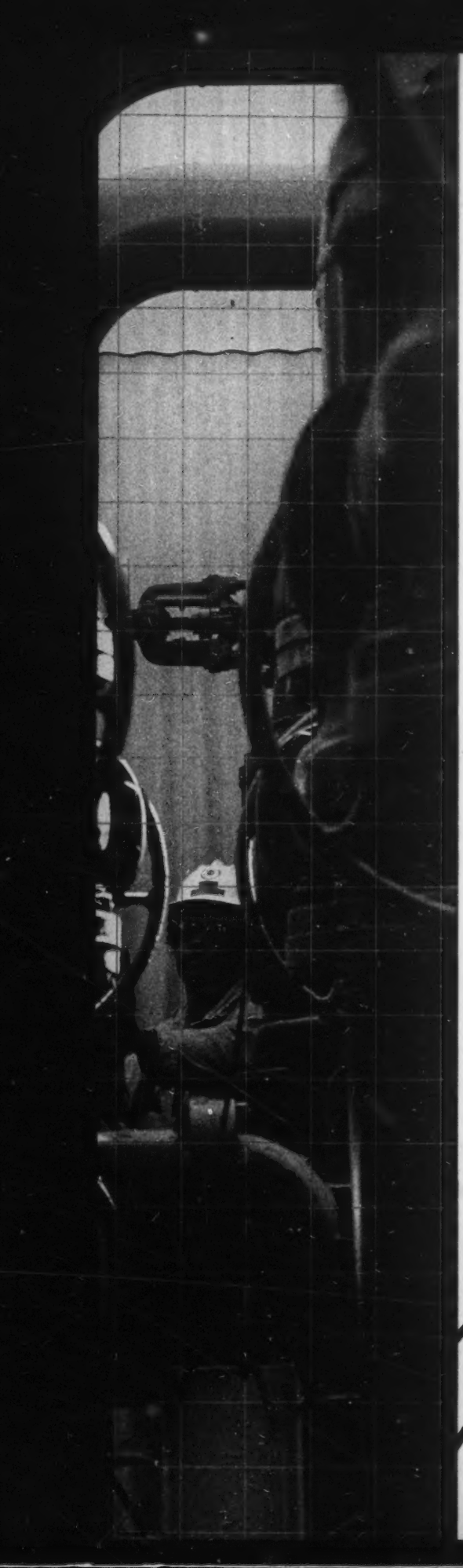
for the chemical industry

No expansion lasts forever, and, as the data graphed and tabulated on the following pages of C&EN's annual Facts & Figures issue show, 1990 clearly marked the end of the strong growth the U.S. chemical industry enjoyed through much of the late 1980s.

Still, by some measures, 1990 was not a bad year for chemical makers, more of a lackluster one. Sales continued to rise, as they have every year since 1981, though not enough to offset rising raw materials costs. Production posted its second year of only modest expansion, thanks to softening in most important end-use markets for chemicals, particularly housing construction and automobiles. But earnings fell for the second year in a row for the 30 major chemical makers C&EN regularly surveys—22% in 1990.

And the outlook is for more of the same before things get better. With no turnaround yet in major chemicals markets, more plants coming on stream at a time when capacity utilization is already soft, and the prospect of continuing tightness in raw materials supplies, thanks to events in the Middle East, 1991 isn't shaping up as a turnaround year.

The data presented on the following pages illustrate statistically the overall health of the chemical industry both in the U.S. and, to a lesser extent, in several other important chemical-producing nations. The data pulled together here come from a variety of sources, such as government agencies, trade associations, and international organizations, as well as the individual companies that comprise the chemical industry. In many cases, these raw data have been used by C&EN's staff to develop analytical measures and comparisons that help put the industry's recent results into better perspective.



At a glance

Section One: Production

The U.S. chemical industry raised output last year 3%, making 1990 the second year in a row of only modest production increases. Most major sectors of the industry held fairly steady for the year; only plastics, led by 15% increases in output for both polypropylene and low-density polyethylene, showed significant gains. The biggest volume commodity chemicals generally posted gains for the year. **Page 30**

Section Two: Finances

Although sales continued to climb, setting yet another all-time high in 1990, rising raw materials costs and softening capacity utilization ate into profits and profitability for chemical makers. Overall, earnings dropped 22% among the 30 companies C&EN tracks. Capital spending, however, remained strong, and R&D expenditures increased. **Page 39**

Section Three: Employment

The number of people working in the chemical industry was essentially unchanged last year at nearly 1.09 million. Scientists and engineers among that number rose to 78,400 in January 1990, 1% higher than their level a year earlier. Women were 30% of the chemical work force in 1989, compared with 33% for manufacturing workers generally. Among the larger chemical companies, overall employment declined 2% in 1990. **Page 58**

Section Four: Markets

Chemical markets, like the U.S. economy as a whole, were soft in 1990. As the overall economy moved into a recession at year's end, key markets for chemicals—such as new housing and automobiles—were posting only the latest of several poor years. Agriculture, on the other hand, did well in 1990. **Page 62**

Section Five: Foreign Trade

U.S. firms exported almost $39 billion in chemicals last year, setting a record high chemical trade surplus of $16.5 billion. Chemical trade worldwide was strong, up 12% when measured in U.S. dollars, though trade volume grew somewhat less. Germany, long the world's largest exporter and importer of chemicals, strengthened its lead in both categories, thanks to unification. **Page 64**

Section Six: Foreign Chemical Industries

Slowdown was evident in the chemical industry throughout the world in 1990. In Western Europe, drugmakers boosted earnings, but more purely chemical makers did not. Although Japanese production grew for many chemicals, sharp rises in oil costs took their toll in company earnings. Recession cut volume and prices for many Canadian chemicals. And Eastern Europe and the Soviet Union posted their worst year in more than four decades. **Page 66**

Little change in chemical output last year

Production by U.S. chemical makers held steady in 1990. The softening of growth that was evident in most sectors of the chemical industry by the end of 1989 never quite became an actual decline in production during 1990. Instead, by most measures, production changed little last year.

According to the Federal Reserve Board, production of chemicals and allied products rose a modest 2% overall in 1990, somewhat less than the 3% gain made in 1989, and right in line with the 2% average annual performance for the group over the past 10 years. The largest volume chemicals, C&EN's Top 50, didn't perform as well, posting a 1.4% gain in 1990 after an annual gain of only 0.8% in 1989. Output for the major organic chemicals rose 1% in 1990, while inorganic production was up 1.6%. Though only inching upward, production for these 50 largest volume chemicals has set new all-time highs each year for the past three.

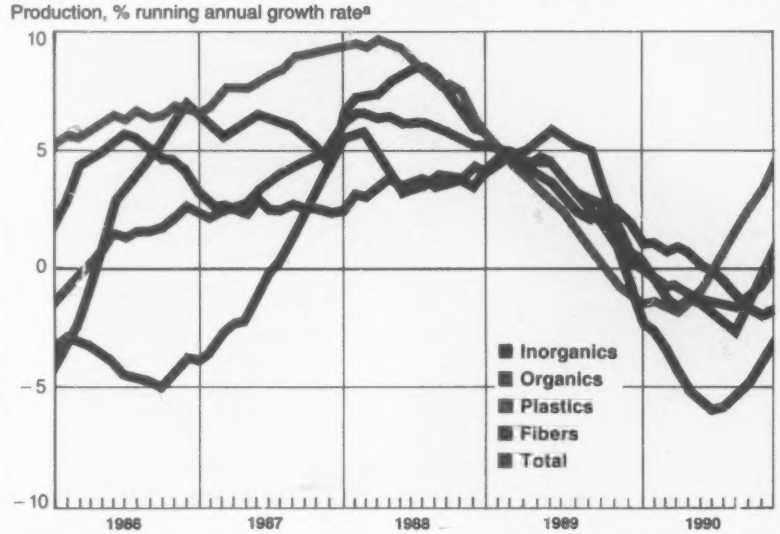
Plastics had the best year of the major chemical sectors, with overall production up 9% in 1990, according to Federal Reserve Board data, and 8% as measured by the Society of the Plastics Industry. But other synthetic materials fared less well. Synthetic rubber production was off 4% for the year as were man-made fibers, including cellulosics. Fertilizers, too, had a moderately good year, with all three major nutrients posting production gains of 5 to 8% for the 1990 crop year, which ended June 30.

Some of the biggest losses in production were among large-volume inorganic chemicals. Although the group as a whole rose 1.6% for the year, hydrochloric acid fell 26%, calcium chloride fell 28%, and ammonium nitrate fell 10%. In contrast, sodium hydroxide rose 11% and ammonia rose 4%.

As mandated by the Montreal protocol, production of chlorofluorocarbons fell sharply in 1990.

Plastics only chemical sector to show much growth in 1990

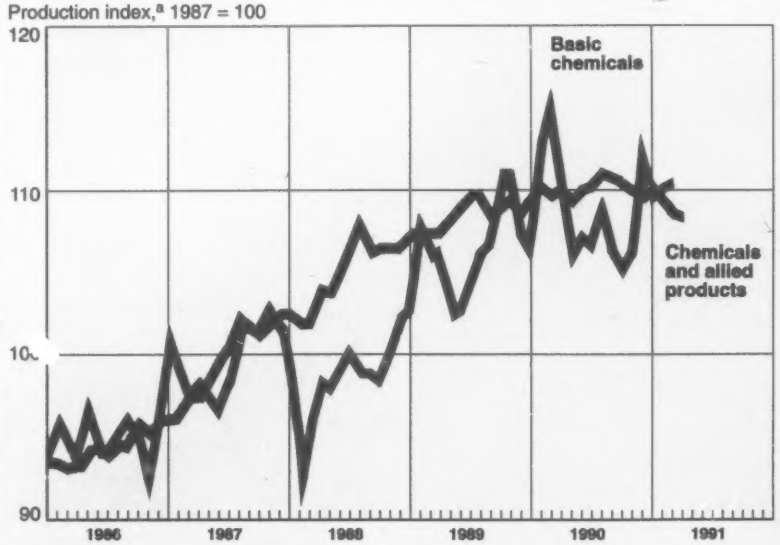
Production, % running annual growth rate[a]



a Average running annual growth rates in production of major plastics, inorganic and organic chemicals, and all chemicals, and in shipments of man-made fibers. **Sources:** International Trade Commission, Bureau of the Census, Society of the Plastics Industry, Textile Economics Bureau

Chemicals hold on to production gains of late 1980s

Production index,[a] 1987 = 100



a Seasonally adjusted. **Source:** Federal Reserve Board

TOP 50 CHEMICALS: Very modest growth last year for both organics and inorganics

Rank			Billions of lb		Common units[b]		Average annual growth			
1990	1989[a]		1990	1989	1990	1989	1989–90	1988–89	1985–90	1980–90
1	1	Sulfuric acid	88.56	86.60	44,281 tt	43,301 tt	2.3%	2.8%	2.1%	0 %
2	2	Nitrogen	57.32	53.91	791 bcf	744 bcf	6.3	3.0	3.8	5.1
3	3	Oxygen	38.99	37.42	471 bcf	452 bcf	4.2	0	3.7	0.9
4	4	Ethylene	37.48	34.99	37,480 mp	34,994 mp	7.1	−5.9	4.7	2.7
5	5	Lime[c]	34.80	34.36	17,400 tt	17,178 tt	1.3	0.7	1.9	−0.9
6	6	Ammonia	33.92	32.72	16,958 tt	16,362 tt	3.6	−2.7	−0.4	−1.5
7	7	Phosphoric acid	24.35	23.47	12,175 tt	11,735 tt	3.7	0.5	3.0	1.2
8	9	Sodium hydroxide	23.38	20.98	11,688 tt	10,492 tt	11.4	−0.3	1.4	0.1
9	10	Propylene	22.12	20.58	22,117 mp	20,575 mp	7.5	−3.1	8.2	4.9
10	8	Chlorine	21.88	22.83	10,942 tt	11,413 tt	−4.1	1.4	1.0	−0.4
11	11	Sodium carbonate[d]	19.85	19.83	9,925 tt	9,915 tt	0.1	2.9	3.1	1.8
12	13	Urea[e]	15.81	15.93	7,905 tt	7,963 tt	−0.7	0.6	3.4	0.1
13	12	Nitric acid	15.50	16.70	7,749 tt	8,349 tt	−7.2	4.5	1.0	−1.7
14	14	Ammonium nitrate[f]	14.21	15.74	7,107 tt	7,871 tt	−9.7	4.9	1.0	−2.5
15	15	Ethylene dichloride	13.30	13.39	13,301 mp	13,385 mp	−0.6	2.7	1.9	1.8
16	16	Benzene	11.86	11.94	1,610 mg	1,621 mg	−0.7	1.8	4.8	−2.2
17	17	Carbon dioxide[g]	10.98	10.68	5,491 tt	5,339 tt	2.8	5.6	1.9	6.2
18	18	Vinyl chloride	10.65	10.14	10,652 mp	10,137 mp	5.1	11.9	2.4	5.1
19	19	Ethylbenzene	8.99	9.24	8,988 mp	9,238 mp	−2.7	−7.0	4.0	1.6
20	21	Styrene	8.02	8.34	8,018 mp	8,338 mp	−3.8	−7.2	1.0	1.6
21	22	Methanol	7.99	8.17	7,987 mp	8,168 mp	2.2	0.3	9.8	1.1
22	20	Terephthalic acid[h]	7.69	8.43	7,692 mp	8,427 mp	−8.7	−17.7	3.5	2.4
23	23	Formaldehyde[i]	6.41	5.89	6,413 mp	5,894 mp	8.8	−6.1	2.7	1.4
24	30	Methyl *tert*-butyl ether[j]	6.30	8.23	6,302 mp	8,229 mp	−23.4	44.9	27.2	na
25	25	Toluene[k]	6.10	5.81	841 mg	801 mg	5.0	−8.5	3.8	−1.9
26	26	Xylene	5.70	5.80	791 mg	805 mg	−1.7	5.8	1.4	−1.4
27	29	Ethylene oxide	5.58	5.03	5,581 mp	5,032 mp	10.9	−15.5	0.6	0.7
28	28	*p*-Xylene	5.20	5.35	5,201 mp	5,345 mp	−2.7	−4.6	1.7	2.1
29	27	Ethylene glycol	5.03	5.46	5,028 mp	5,462 mp	−7.9	−1.0	3.8	1.4
30	31	Ammonium sulfate	4.99	4.69	2,495 tt	2,347 tt	6.3	0.6	3.6	1.6
31	24	Hydrochloric acid	4.68	6.35	2,341 tt	3,177 tt	−26.3	20.3	−3.5	−2.1
32	32	Cumene	4.31	4.43	4,312 mp	4,427 mp	−2.6	−0.6	5.2	2.2
33	34	Acetic acid	3.76	3.29	3,756 mp	3,294 mp	14.0	4.3	5.3	2.4
34	35	Potash[l]	3.62	3.52	1,640 tmt	1,595 tmt	2.8	4.9	4.8	−3.1
35	33	Phenol[m]	3.51	3.81	3,512 mp	3,807 mp	−7.7	6.9	4.8	3.2
36	36	Propylene oxide	3.20	3.20	3,200 mp	3,200 mp	0	2.9	5.9	6.1
37	37	Butadiene[n]	3.16	3.12	3,156 mp	3,122 mp	1.1	−1.5	6.2	1.2
38	39	Acrylonitrile	3.03	2.36	3,029 mp	2,363 mp	28.2	−9.4	5.2	5.2
39	38	Carbon black	2.87	2.91	2,868 mp	2,913 mp	−1.5	−0.1	2.2	1.2
40	42	Vinyl acetate	2.55	2.55	2,546 mp	2,553 mp	−0.3	−0.3	3.8	2.8
41	43	Cyclohexane	2.47	2.27	2,468 mp	2,274 mp	8.5	−1.0	8.3	2.3
42	41	Aluminum sulfate	2.42	2.49	1,208 tt	1,244 tt	−2.9	1.0	−1.0	−0.6
43	40	Acetone	2.22	2.53	2,221 mp	2,525 mp	−12.0	9.6	4.4	0.7
44	44	Titanium dioxide	2.16	2.20	1,079 tt	1,101 tt	−2.0	7.7	4.6	4.2
45	46	Sodium silicate	1.76	1.67	878 tt	834 tt	5.3	2.7	4.9	0.9
46	47	Adipic acid	1.64	1.64	1,640 mp	1,640 mp	0	2.5	2.5	1.1
47	48	Sodium sulfate[o]	1.47	1.51	733 tt	755 tt	−2.9	−7.6	−2.4	−4.3
48	45	Calcium chloride[p]	1.38	1.92	690 tt	962 tt	−28.3	32.0	−2.9	−3.5
48	49	Isopropyl alcohol	1.38	1.47	1,380 mp	1,474 mp	−6.4	6.1	2.2	−2.8
48	50	Caprolactam	1.38	1.31	1,380 mp	1,308 mp	5.2	4.0	5.0	4.3
TOTAL ORGANICS			**216.82**	**214.88**			**1.0%**	**−1.4%**	**4.6%**	**2.1%**
TOTAL INORGANICS			**409.07**	**402.51**			**1.6%**	**2.0%**	**2.1%**	**0.5%**
GRAND TOTAL			**625.89**	**617.19**			**1.4%**	**0.8%**	**2.9%**	**1.0%**

a Revised. b tt = thousands of tons, bcf = billions of cubic feet, mp = millions of pounds, mg = millions of gallons, tmt = thousands of metric tons. c Except refractory dolomite. d Natural and synthetic. e 100% basis. f Original solution. g Liquid and solid only. h Includes both acid and ester without double counting. i 37% by weight. j Production data for earlier years unavailable. k All grades. l K_2O basis. m Synthetic only. n Rubber grade. o High and low purity. p Solid and liquid. na = not available.

PRODUCTION: Like manufacturing as a whole, most chemicals rose only slightly in 1990

Industrial production indexes, 1987 = 100	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
Total index	109.2	108.1	105.4	100.0	95.3	94.4	92.8	84.9	81.9	85.7	84.1	1%	3%
Manufacturing, total	109.9	108.9	105.8	100.0	94.3	91.6	89.3	80.9	76.6	80.3	78.8	1	3
Nondurable manufacturing	107.8	106.4	103.6	100.0	94.9	91.5	90.8	87.0	82.5	84.5	83.1	1	3
Chemicals and products	110.3	108.5	105.4	100.0	94.6	91.4	91.4	87.5	81.8	89.2	87.8	2	2
Chemicals and synthetic materials	107.2	106.5	102.5	100.0	93.9	92.2	92.8	88.6	79.4	91.2	86.3	1	2
Basic chemicals	108.6	106.6	98.3	100.0	95.1	96.1	96.9	92.1	86.5	96.9	96.5	2	1
Alkalies and chlorine	99.5	103.2	96.0	100.0	92.1	93.6	95.3	87.9	82.1	94.6	101.5	−4	0
Industrial gases	109.2	108.0	104.1	100.0	98.8	92.8	97.5	85.9	80.1	91.2	91.5	1	2
Inorganic pigments	104.3	111.0	102.6	100.0	96.2	95.1	89.0	87.3	79.1	90.7	90.6	−6	1
Inorganic chemicals, nec	110.1	105.7	96.4	100.0	94.7	97.2	98.0	94.3	89.2	98.7	96.8	4	1
Industrial organic chemicals	107.1	109.2	103.1	100.0	95.1	94.1	93.4	89.9	81.0	97.0	92.8	−2	1
Synthetic materials	106.5	103.1	104.4	100.0	91.6	86.9	88.9	84.3	71.8	79.5	71.2	3	4
Plastics materials	115.8	106.7	106.8	100.0	88.2	84.1	81.1	74.4	64.4	68.3	64.2	9	6
Synthetic rubber	88.6	92.4	105.0	100.0	109.3	114.4	132.8	124.1	110.5	114.5	110.8	−4	−2
Man-made fibers	92.7	98.7	99.5	100.0	93.7	86.6	93.3	92.3	76.4	91.7	74.9	−6	2
Chemical products	113.3	110.1	107.5	100.0	95.9	90.2	89.0	86.6	83.0	85.4	87.6	3	3
Drugs and medicines	114.0	108.1	107.2	100.0	96.7	88.5	86.9	86.1	82.7	80.9	80.2	5	4
Soaps and toiletries	112.3	111.1	107.9	100.0	96.7	91.3	90.6	91.4	89.2	97.7	103.5	1	1
Paints	99.5	104.8	103.9	100.0	97.5	95.7	91.8	84.6	78.8	84.1	87.0	−5	1
Agricultural chemicals	105.1	108.2	107.2	100.0	88.5	96.1	102.0	87.5	88.8	102.3	97.2	−3	1
Petroleum products	108.2	106.1	103.4	100.0	98.9	92.6	92.8	89.6	89.3	94.1	99.0	2	1
Rubber and plastics products	110.2	108.9	105.9	100.0	90.8	85.8	83.8	74.3	65.9	66.6	61.7	1	6

nec = not elsewhere classified. **Source:** Federal Reserve Board

MINERALS: Only potash, which is largely imported, showed strong growth in 1990

Thousands of tons	1990[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
Bromine, sold or used[b]	193	193[a]	180	168	155	160	193	185	200	189	189	0%	0%
Calcium chloride, production[c,d]	690	801[a]	731	658	780	940	1,036	912	853	917	811	−14	−2
Lime, sold or used[e]	17,400	17,178	16,658	15,733	14,474	15,690	15,922	14,867	14,075	18,890	19,037	1	−1
Lithium, consumption[d,f]	3.0	3.0	3.0	2.7	2.6	2.5	3.2	2.2	2.0	3.2	3.0	0	0
Phosphate rock													
Marketable production	50,700	54,913	50,000	45,145	4 445	56,035	54,230	46,928	41,241	59,110	59,982	−8	−2
Exports	7,700	8,644	8,920	9,319	8,651	10,071	12,707	13,239	10,849	11,458	15,737	−11	−7
Potash (K_2O equivalent)[g]													
Production	1,810	1,758	1,677	1,391	1,325	1,429	1,724	1,575	1,967	2,377	2,468	3	−3
Imports	4,590	3,759	4,648	4,490	4,643	5,063	5,323	4,894	4,253	5,287	5,481	22	−2
Apparent consumption	5,680	4,960	5,803	5,609	5,338	5,893	6,638	6,231	5,647	6,849	6,999	15	−2
Salt, production[h]	39,400[d]	39,278	39,170	36,943	37,282	39,217	39,181	32,973	37,665	38,899	40,396	0	nc
Evaporated[i]	6,700[d]	7,070	7,203	6,896	6,316	6,162	6,334	5,276	5,273	6,206	6,358	−5	nc
Rock[i]	14,200[d]	14,140	12,750	12,230	13,333	13,990	13,653	11,870	12,806	11,866	11,806	0	nc
Salt in brine[i]	18,500[d]	18,068	19,218	17,817	17,633	19,065	19,195	15,827	19,586	20,826	22,231	2	nc
Sodium carbonate, production[j]	10,098	9,915	9,632	8,891	8,438	8,511	8,511	8,467	7,819	8,281	8,275	2	2
Sulfur, production[k]	12,484	12,778	11,845	11,616	12,221	12,797	11,742	10,240	10,788	13,388	13,080	−2	0
Apparent consumption[l]	14,082	13,983	14,012	12,481	11,669	13,192	13,976	12,112	11,088	14,093	15,056	1	−1
Frasch, production	3,968	4,286	3,499	3,530	4,457	5,524	4,622	3,530	4 241	6,997	7,044	−7	−6
Recovered elemental, production	7,110	7,176	7,103	6,791	6,411	5,857	5,747	5,462	4,805	4,695	4,490	−1	5
Other, production	1,405	1,316	1,243	1,296	1,354	1,416	1,372	1,249	1,293	1,695	1,547	7	−3

a Preliminary. b Elemental bromine sold as such or used in preparation of bromine compounds by primary producers. c 75% $CaCl_2$ equivalent. d Estimated. e Includes Puerto Rican production. f Lithium content basis. g Includes muriate and sulfate of potash, potassium magnesium sulfate, and parent salts; excludes other chemical compounds containing potassium. h Figures for 1980 are total obtained by all recovery methods that was sold or used by domestic producers (slightly different from U.S. production); figures for 1980–81 include Puerto Rican production. i Sold or used as such. j Natural and synthetic for 1980–86, natural only in 1987–90. k Sulfur content basis. l Calculated from shipments plus imports minus exports (sulfur content basis). nc = not comparable. **Sources:** Bureau of Mines, Bureau of the Census

1 Production by the U.S. Chemical Industry

ORGANIC CHEMICALS: Biggest volume organics generally did well in otherwise mixed field

Millions of lb unless otherwise noted	Production											Annual change	
	1990[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Acetic acid, synthetic	3,755	3,294	3,159	3,246	2,728	2,897	2,619	2,807	2,748	2,705	2,977	14%	2%
Acetone	2,221	2,524	2,303	1,846	1,910	1,788	1,862	1,859	1,694	2,144	2,076	−12	1
Acrylonitrile	3,029	2,362	2,609	2,452	2,182	2,349	2,219	2,146	2,035	1,997	1,830	28	5
Aniline	947	1,016	1,029	829	824	716	786	663	557	634	659	−7	4
Benzene, mg[b,c]	1,615	1,631	1,608	1,575	1,362	1,283	1,318	1,232	1,052	1,308	1,534	−1	1
Bisphenol A	1,141	1,241	1,340	1,000	956	949	762	643	480	555	530	−8	8
1,3-Butadiene[d]	3,155	3,121	3,169	2,931	2,546	2,340	2,452	2,353	1,915	2,986	2,799	1	1
1-Butanol	1,269	1,751	1,194[e]	1,155	881	716	908	833	730	809	790	−28	5
Caprolactam	1,379	1,307	1,261	1,156	1,109	1,089	1,027	977	793	928	905	5	4
Carbon tetrachloride	271	na	761	672	627	646	713	573	587	726	710	—	−9
Chloroform	497	588	524	462	422	275	405	362	299	405	273	−15	6
Cumene	4,311	4,426	4,455	4,105	3,745	2,627	3,754	3,345	2,743	3,309	3,459	−3	2
Cyclohexane	2,467	2,273	2,297	2,276	2,070	1,657	1,994	1,656	1,275	1,820	1,964	9	2
Dioctyl phthalate	302	306	344	343	296	275	301	300	266	304	353	−1	−2
Ethanol, synthetic	na	549	562	574	529	649	1,060	1,077	1,023	1,317	1,451	—	--
Ethanolamines[e]	679	667	608	627	543	537	504	468	416	429	376	2	6
Ethylbenzene	8,987	9,235	9,929	9,346	9,020	7,386	7,562	7,876	6,656	7,813	7,642	−3	2
Ethyl chloride	na	162	152	155	164	171	290	282	339	324	396	—	—
Ethylene	37,474	34,988	37,204	34,951	32,859	29,847	31,383	28,680	24,501	29,418	28,667	7	3
Ethylene dichloride	13,299	13,383	13,028	12,197	12,940	12,101	10,710	11,506	7,619	9,974	11,108	−1	2
Ethylene glycol	5,027	5,461	5,517	5,183	4,771	4,178	4,823	4,425	4,309	4,143	4,386	−8	1
Ethylene oxide	5,580	5,031	5,953	4,785	5,430	5,430	5,699	5,534	4,987	4,937	5,220	11	1
2-Ethylhexanol	596	612	743	662	571	536	541	387	325	389	367	−3	5
Formaldehyde, 37%[f]	6,412	5,893	6,280	5,733	5,549	5,606	5,815	5,465	4,817	5,721	5,555	9	1
Isobutylene	1,145	1,193	1,244	1,035	1,124	na	883	760	741	1,035	1,052	−4	1
Isopropyl alcohol	1,380	1,474	1,389	1,371	1,301	1,235	1,394	1,209	1,380	1,669	1,836	−6	−3
Maleic anhydride	418	475	448	382	359	394	359	299	260	293	304	−12	3
Methanol, synthetic	7,986	8,167	8,142	7,537	7,205	5,003	8,186	7,982	7,555	8,577	7,153	−2	1
Methyl chloride	498	461	597	373	605	410	482	409	366	405	362	8	3
Methyl ethyl ketone	473	450	482	672	600	537	543	531	468	614	692	5	−4
Methyl methacrylate	1,207	1,161	1,100	1,029	943	858	917	844	721	592	564	4	8
Methylchloroform	785	783	724	694	652	869	675	586	595	611	587	0	3
Methylene chloride	471	482	504	516	566	467	607	584	532	691	780	−2	−5
Perchloroethylene	384	481	498	473	414	678	573	547	585	691	765	−20	−7
Phenol, synthetic[g]	3,512	3,806	3,562	3,351	3,115	2,841	2,889	2,638	2,023	2,578	2,568	−8	3
Phthalic anhydride	941	917	999	1,035	863	820	870	838	684	870	818	3	1
Propylene[h]	22,113	20,571	21,224	19,019	16,522	14,887	15,559	13,959	12,535	13,482	13,676	8	5
Propylene glycol	800	805	840	747	573	500	462	484	400	473	488	−1	5
Styrene, monomer	8,017	8,337	8,984	8,014	7,888	7,622	7,709	6,802	5,942	6,679	6,856	−4	2
Terephthalic acid, dimethyl ester[i]	7,690	8,426	10,234	7,601	6,257	6,490	5,912	5,626	4,843	6,235	6,054	−9	2
Toluene, mg[b,j]	843	806	892	967	611	698	728	780	714	852	1,010	5	−2
Vinyl acetate	2,545	2,552	2,561	1,813	1,710	2,112	2,024	1,963	1,876	1,936	1,922	0	3
Vinyl chloride	10,650	10,135	9,058	8,402	8,439	9,463	6,094	6,875	4,902	6,874	6,466	5	5
***o*-Xylene**	943	983	971	940	788	675	688	781	802	918	995	−4	−1
***p*-Xylene**	5,200	5,344	5,601	5,155	5,035	4,779	4,264	4,114	3,391	4,532	4,238	−3	2

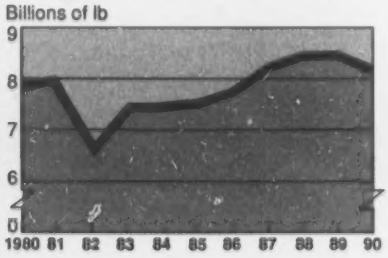
Note: mg = millions of gallons. a Preliminary. b Tar distillers and coke-oven operators not included. c Specification grades. d Rubber grade. e Mono-, di-, and triethanolamines. f By weight. g Does not include data for coke ovens and gas-retort ovens. h All grades. i Includes both acid and dimethyl ester (DMT), without double counting. j High-purity toluene, includes material used in blending motor fuel. na = not available. **Source:** International Trade Commission

INORGANICS: Mixed results mark production for both the year and the decade

Thousands of tons unless otherwise noted	Production											Annual change	
	1990[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Aluminum sulfate[b]	1,208	1,243	1,237	1,227	1,222	1,268	1,129	1,119	1,154	1,294	1,286	−3%	−1%
Ammonia, 100%[c,d]	16,958	16,362	16,821	16,098	14,487	17,319	16,692	14,072	15,801	19,044	19,653	4	−1
Ammonium nitrate, 100%[e]	7,107	7,871	7,504	6,547	6,091	7,149	7,146	6,240	7,091	8,861	9,128	−10	−2
Ammonium sulfate, 100%[d,f]	2,495	2,347	2,333	2,189	2,080	2,093	2,067	1,956	1,768	2,185	2,136	6	2
Chlorine gas[g]	10,943	11,413	11,257	11,078	10,436	10,402	10,700	9,960	9,176	10,763	11,421	−4	0
Hydrochloric acid, 100%[h]	2,341	3,177	3,228	2,996	2,413	2,807	2,732	2,468	2,450	2,574	2,888	−26	−2
Hydrogen, bcf, 100%[i,j]	188	208	177	173	136	121	109	103	88	105	107	−10	6
Hydrogen peroxide, 100%[k]	204	204	168	153	152	144	139	117	108	111	116	0	6
Nitric acid, 100%[k]	7,749	8,349	7,991	7,225	6,734	7,631	7,726	6,768	7,390	9,093	9,231	−7	−2
Nitrogen gas, bcf, 100%[i,l]	791	744	722	685	677	665	661	560	483	490	479	6	5
Oxygen, bcf, 100%[i,l]	471	452	452	405	383	393	375	346	349	431	431	4	1
Phosphoric acid, 100% P_2O_5	12,175	11,737	11,659	10,599	9,578	10,607	11,370	9,767	8,253	9,958	10,848	4	1
Phosphorus[m]	356	353	343	344	364	359	386	366	361	426	432	1	−2
Sodium chlorate, 100%	308	290	267	289	267	259	295	323	291	297	312	6	0
Sodium hydroxide, 100%	11,688	10,491	10,533	11,553	10,691	10,811	10,914	10,039	9,385	10,621	11,625	11	0
Sodium phosphate[n]	568[o]	610[o]	549	586	617	625	675	669	651	606	727	−7	−2
Sodium silicate[p]	878	833	812	952	791	692	685	710	664	771	805	5	1
Sodium sulfate, 100%[q]	733	755	819	799	837	1,203	901	914	864	1,111	1,140	−3	−4
Sulfuric acid, 100%[r]	44,281	43,301	42,580	39,256	35,993	39,890	41,802	36,583	33,233	40,742	44,158	2	0
Titanium dioxide, 100%[s]	1,079	1,101	1,022	968	931	860	835	760	660	761	727	−2	4
Urea	7,905	7,963	7,914	7,433	6,264	6,975	7,433	6,137	6,470	8,062	7,830	−1	0

Note: bcf = billions of cubic feet. a Preliminary. b Commercial, 17% Al_2O_3; includes municipalities. c Synthetic anhydrous. d Excludes by-product ammonia liquor and ammonium sulfate. e Original solution. f Synthetic and noncoke by-product. g Includes quantities liquefied for use, storage, or shipment. h Includes anhydrous hydrochloric acid production. i High- and low-purity gas. j Liquid and gas; excludes amounts vented and used as fuel, and amounts produced in petroleum refineries for captive use. k Includes unspecified amounts produced but not withdrawn from the system. l Excludes amounts produced and consumed in making synthetic ammonia or ammonia derivatives. m Elemental, white (yellow), and red. n Tripolyphosphate (100% $Na_5P_3O_{10}$). o Includes tetrabasic (pyro) phosphate. p Soluble silicate glass (water glass), solid and liquid (anhydrous); excludes amounts produced and consumed in making meta-, ortho-, and sesquisilicates. q Anhydrous, high and low purity, and Glauber's salt. r Gross (new and fortified). s Composite and pure. **Sources:** Department of Commerce, International Trade Commission

Synthetic noncellulosic fibers output



SYNTHETIC FIBERS: Production declines for all fibers except polyolefins

Millions of lb	Production											Annual change	
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
NONCELLULOSIC FIBERS													
Acrylic[a]	506	543	588	592	616	631	671	671	624	691	779	−7%	−4%
Nylon[b]	2662	2740	2669	2689	2514	2343	2412	2419	1927	2332	2358	−3	1
Olefin[c]	1822	1639	1588	1494	1393	1249	997	906	723	785	748	11	9
Polyester	3195	3594	3681	3541	3305	3341	3392	3544	3196	4176	3989	−11	−2
CELLULOSIC FIBERS													
Acetate[d]	505	580	614	605	619	558	199	229	196	261	316	−13	−5
Rayon							421	401	388	509	490		
TOTAL	8690	9096	9140	8921	8447	8122	8092	8168	7027	8754	8680	−4%	0%

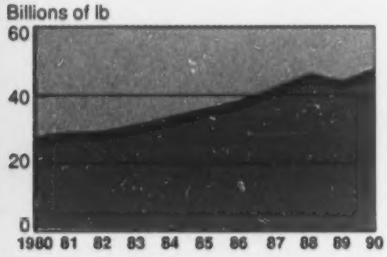
a Includes modacrylic. b Excludes aramid in 1983–87. c Includes olefin yarn and monofilaments and olefin and vinyon staple, tow, and fiberfill. d Includes diacetate and triacetate; excludes production for cigarette filters. **Source:** Fiber Economics Bureau

SYNTHETIC RUBBER: Output decline, which began in 1989, accelerated in 1990

Thousands of metric tons	Production											Annual change	
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Ethylene-propylene	256	260	283	254	230	215	215	175	123	176	144	−2%	6%
Nitrile	56	69	76	69	59	53	67	55	45	66	63	−19	−1
Polybutadiene	403	411	407	371	336	330	359	333	288	342	311	−2	3
Styrene-butadiene rubber	853	874	909	850	792	735	958	904	876	1032	1074	−2	−2
Other[a]	546	647	679	638	596	505	556	468	498	404	423	−16	3
TOTAL	**2114**	**2261**	**2335**	**2182**	**2013**	**1838**	**2155**	**1935**	**1830**	**2022**	**2015**	**−7%**	**0%**

a Includes butyl, polychloroprene, polyisoprene, silicone, and other synthetic elastomers. Some values are estimated. **Source:** Rubber Manufacturers Association

Plastics production



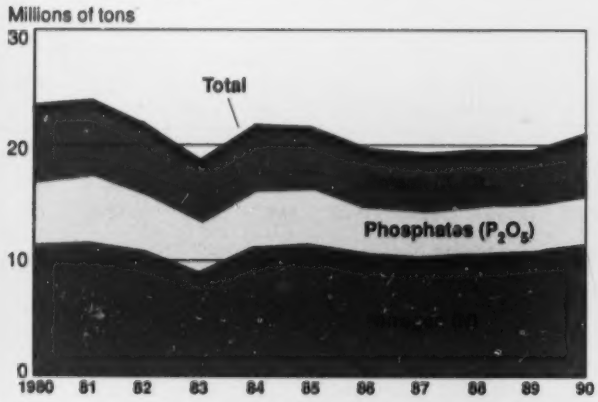
PLASTICS: Production of major resins moved ahead last year

Millions of lb[a]	Production											Annual change	
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
THERMOSETTING RESINS													
Epoxy[b]	499	509	486	433	398	385	406	334	286	336	315	−2%	5%
Melamine	202	222	207	212	173	192	210	180	158	179	167	−9	2
Phenolic[c]	2,946[d]	2,879[d]	3,066[d]	2,869[d]	2,735[d]	2,621[d]	2,502[d]	2,477[d]	2,006[d]	2,333[d]	1,499	2	nc
Polyester[e]	1,221	1,319	1,404	1,367	1,271	1,223	1,232	1,084	865	997	947	−7	3
Urea	1,496	1,477	1,425	1,382	1,271	1,210	1,199	1,172	998	1,165	1,165	1	3
TOTAL	**6,364**	**6,408**	**6,588**	**6,263**	**5,648**	**5,631**	**5,549**	**5,247**	**4,313**	**5,010**	**4,093**	**−1%**	**nc%**
THERMOPLASTIC RESINS													
Polyethylene													
Low density[f]	11,176	9,695	10,397	9,599	8,903	8,889	8,413	8,041	7,503	7,693	7,291	15	4
High density[g]	8,334	8,102	8,400	7,995	7,182	6,671	6,085	5,689	4,928	4,695	4,405	3	7
Polypropylene	8,318	7,238	7,274	6,647	5,812	5,139	4,940	4,433	3,477	3,955	3,648	15	9
Styrene polymers													
Polystyrene	5,012	5,104	5,187	4,780	4,470	4,054	3,838	3,570	3,191	3,621	3,521	−2	4
Styrene-acrylonitrile	134	113	148	126	92	87	99	93	91	107	111	19	2
Acrylonitrile-butadiene-styrene and other styrene polymers[h]	2,335	2,394	2,418	2,254	2,196	2,036	2,127	1,889	1,380	1,745	1,705	−2	3
Polyamide, nylon type	556	569	566	507	465	399	396	321	228	312	274	−2	7
Vinyl resins													
Polyvinyl chloride and copolymers	9,088	8,478	8,350	7,971	7,256	6,772	6,760	6,067	5,326	5,707	5,470	7	5
Other vinyl resins[i]	226	220	222	212	195	190	187	186	177	208	196	3	1
Thermoplastic polyester	1,879	1,630	1,652	1,394	1,175	965	899	778	648	609	na	15	—
TOTAL	**47,058**	**43,543**	**44,614**	**41,485**	**37,746**	**35,202**	**33,744**	**31,067**	**26,949**	**28,652**	**26,621**	**8%**	**6%**

Note: Totals are for those products listed and exclude some small-volume plastics. a Dry-weight basis unless otherwise specified. b Unmodified. c Includes other tar acid resins. d Gross-weight basis. e Unsaturated. f Density 0.940 and below. g Density above 0.940. h Includes styrene-butadiene copolymers and other styrene-based polymers. i Includes polyvinyl butyral, polyvinyl formal, and polyvinylidene-chloride. na = not available. nc = not comparable. **Source:** Society of the Plastics Industry

1 Production by the U.S. Chemical Industry

Fertilizer consumption



Note: Years ending June 30. Sources: Department of Agriculture, Fertilizer Institute

FERTILIZERS: All major nutrients had increased use in 1990 crop year

	Consumption										Annual change	
Thousands of tons	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1990–90
Nitrogen (N)	11,076	10,593	10,512	10,210	10,424	11,493	11,092	9,127	10,983	11,924	11,407	5%	0%
Phosphates (P_2O_5)	4,345	4,117	4,129	4,008	4,178	4,658	4,901	4,138	4,814	5,434	5,432	6	−2
Potash (K_2O)	5,203	4,838	4,973	4,837	5,053	5,553	5,797	4,831	5,631	6,320	6,245	8	−2
TOTAL	**20,624**	**19,548**	**19,614**	**19,055**	**19,655**	**21,704**	**21,790**	**18,096**	**21,428**	**23,678**	**23,084**	**6%**	**−1%**

Note: Years ending June 30. Source: Fertilizer Institute

FERTILIZER PRODUCTION: Phosphate rock declined, ammonia and potash showed little change

									Annual change	
Thousands of tons	1990	1989	1988	1987	1986	1985	1984	1983	1989–90	1983–90
NITROGEN PRODUCTS										
Ammonia	14,167	14,192	14,136	13,357	12,565	16,594	16,613	13,361	0%	1%
Ammonium nitrate	2,579	2,528	2,765	2,472	2,250	3,178	3,365	3,232	2	−2
Ammonium sulfate	2,395	2,327	2,260	2,153	2,058	2,343	2,078	1,969	3	2
Urea	4,231	4,253	4,501	4,253	3,564	3,975	4,889	4,112	−1	0
Nitrogen solutions	4,750	5,644	6,999	5,988	5,945	7,928	7,999	6,385	−16	−3
PHOSPHATE PRODUCTS										
Diammonium phosphate	13,860	13,507	11,575	9,537	7,492	10,800	12,358	10,264	3	4
Monoammonium phosphate	2,252	1,991	1,818	1,679	1,416	1,641	1,654	1,423	13	6
Concentrated superphosphate	1,998	1,777	2,032	2,049	2,127	2,570	2,404	2,684	12	−3
Phosphate rock	44,311	47,676	42,220	39,330	36,227	49,348	47,465	40,664	−7	1
Phosphoric acid (P_2O_5)	11,344	10,962	10,234	8,903	8,085	9,837	10,899	9,182	3	3
POTASH PRODUCTS										
Potassium chloride	2,350	2,316	2,243	1,810	1,715	1,713	2,168	1,928	1	3

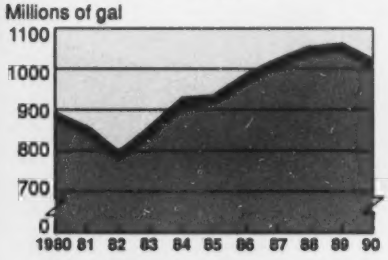
Note: Figures are based on Fertilizer Institute surveys and may not represent the entire industry. Source: Fertilizer Institute

PESTICIDES: Strong growth in 1989 helps insecticides recover from declines of early 1980s

Millions of lb	Production											Annual change	
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1988–89	1979–89
Herbicides[a]	697	702	556	725	756	716	604	623	839	806	657	−1%	1%
Insecticides[b]	424	352	379	342	370	350	306	379	448	506	617	20	−4
Fungicides[c]	111	110	105	113	109	123	106	111	143	156	155	1	−3
TOTAL	1232	1164	1040	1180	1235	1189	1017	1113	1430	1468	1429	6%	−1%

a Includes plant growth regulators. b Includes rodenticides, soil conditioners, and fumigants. c Includes dithiocarbamates. Source: International Trade Commission

Paints and coatings shipments



COATINGS: Decline in major uses drops overall volume below 1989 level

Millions of gal	Shipments											Annual change	
	1990[a]	1989[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Architectural	517	552	536	527	501	477	457	433	374	417	439	−6%	2%
Product[b]	324	358	366	340	350	317	336	294	280	312	316	10	0
Special purpose	161	159	154	145	136	145	145	130	129	129	135	1	2
TOTAL	1002	1069	1056	1013	987	939	938	857	783	858	890	−6%	1%

a Preliminary. b For original equipment manufacturers. Source: Department of Commerce

AEROSOLS: Production growth of 1980s has stalled

Millions of units	Production											Annual change	
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Personal products	1050	1015	1100	964	952	879	832	747	628	645	637	3%	5%
Household products	680	680	650	640	635	630	603	586	556	575	580	0	2
Automotive and industrial products	415	475	440	379	375	342	337	303	286	302	310	−13	3
Paints and finishes	350	350	331	307	297	290	307	300	295	313	310	0	1
Insect sprays	190	197	190	190	193	190	184	180	166	173	150	−4	2
Food products	175	175	157	140	136	140	138	132	131	145	130	0	3
Animal products	8	8	8	22	22	15	16	19	19	14	15	0	−6
Miscellaneous	15	12	31	80	18	23	15	15	13	28	30	25	−7
TOTAL	2883	2912	2907	2722	2628	2509	2432	2282	2094	2195	2162	−1%	3%

Source: Chemical Specialties Manufacturers Association

CHLOROFLUOROCARBONS: Production for all major types falls sharply

Millions of lb	Production											Annual change	
	1990[a]	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Chlorodifluoromethane (F-22)	306	343	333	275	271	235	254	236	174	252	227	−11%	3%
Dichlorodifluoromethane (F-12)	209	392	414	335	322	302	337	290	258	325	295	−47	−3
Trichlorofluoromethane (F-11)	135	192	249	198	202	176	185	215	140	163	158	−30	−2
All other fluorinated hydrocarbons[b]	na	385	379	354	344	306	337	279	na	na	na	—	—
TOTAL	na	1312	1374	1162	1139	1019	1113	1020	na	na	na	—	—

a Preliminary. b Includes other fluorohalogenated hydrocarbons. na = not available. Source: International Trade Commission

Chemical earnings, profitability decline

Last year brought few surprises for the chemical industry. It was expected that 1990 would be a continuation of the lackluster second half of 1989, and that is just what it turned out to be, although there were some extras that perhaps made the year somewhat worse than some industry observers predicted.

Chief among these was perhaps the runup in raw materials costs brought on by the Middle East situation. This was coupled with already weakening capacity utilization caused by softening in such end-use markets as housing construction and automobiles and other durable goods, and by new plants coming on stream. The result was increased pressure on profits in the chemical industry and a classic cost-price squeeze.

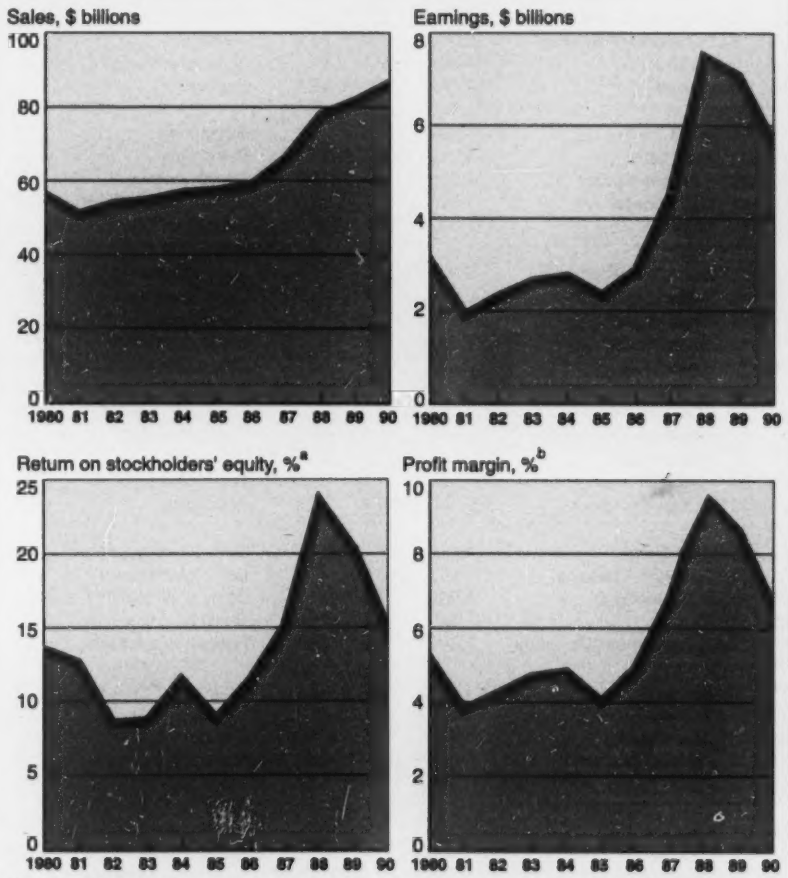
Combined earnings for the 30 major chemical companies regularly surveyed by C&EN dropped 22% in 1990 from the year-earlier level. This is the fourth earnings contraction since 1980, with the others occurring in 1981, 1985, and the small drop-off registered in 1989. But the 22% drop is the largest since earnings fell about 35% in 1981.

Spurred in part by exports and by price increases, sales at the 30 companies held up, however. Sales in 1990 rose about 7% from their 1989 levels, making it yet another record year.

Naturally, 1990 profitability followed earnings on the downward course. Return on year-end stockholders' equity fell to 14.0% in 1990 from 20.2% in 1989. And the average profit margin for the 30 chemical firms dropped to 6.3% last year from 8.6% the year before.

This, however, is not quite so bad as it seems since both measures are still reasonably good on a historical basis. Although during the past few years the industry has gotten fairly spoiled by high returns, profitability in 1990 was still higher than any year during the past decade (except for 1987 through 1989).

Only sales continue to grow as 1990 marks second year of decline for chemical earnings, profitability



Note: Based on data for 30 major chemical companies. a After-tax earnings as a percentage of year-end stockholders' equity. b After-tax earnings as a percentage of sales.

Thus far, the current year is a continuation of 1990. Earnings are continuing on their downward slide from year-earlier levels, causing profitability also to continue downward.

Chemical producers are hoping for an upturn in the second half of this year and, indeed, there are some signs that this may be more than wishful thinking. First-quarter earnings and profitability were both higher than they had been in the fourth quarter of 1990, showing some increased business activity. And some markets, such as residential construction, have in the past couple of months shown some signs of strengthening. Others, however, are still in the doldrums.

However, even if producers are correct in forecasting a better second half, the best they can hope for is that 1991 will be flat when compared with the previous 12 months.

TOP 100 CHEMICAL PRODUCERS: Profits fall substantially for many of the largest firms

Rank 1990	Rank 1989		Chemical sales 1990 ($ millions)	Change from 1989	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1989	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
1	1	Du Pont	$15,571	2.1%	38.9%	Diversified	$1968	−28.9%	40.1%	12.6%	$13,788	36.2%	14.3%
2	2	Dow Chemical	14,690	3.6	74.3	Basic chemicals	1925	−45.7	68.3	13.1	13,604	56.8	14.2
3	3	Exxon	11,153	5.6	9.6	Petroleum	737	−54.1	8.1	6.6	8,548	9.7	8.6
4	4	Union Carbide	7,621[d]	−0.4	100.0	Basic chemicals	1033	−17.0	100.0	13.6	7,613	87.2	13.6
5	5	Monsanto	5,711	−1.2	63.5	Basic chemicals	624	−32.8	68.6	10.9	4,831	52.3	12.9
6	6	Hoechst Celanese	5,499	−2.8	93.5	Basic chemicals	427	−25.9	105.4	7.8	na	na	na
7	8	General Electric	5,167[d]	4.8	8.8	Diversified	1017	−3.8	13.2	19.7	7,973	5.2	12.8
8	7	Occidental Petroleum	5,040	−2.4	23.2	Petroleum	636	−39.8	23.4	12.6	5,494	27.8	11.6
9	9	BASF	4,366	−2.1	81.1	Basic chemicals	na	na	na	na	na	na	na
10	10	Amoco	4,087	−4.4	12.9	Petroleum	252	−66.1	6.4	6.2	3,646	11.5	6.9
11	11	Mobil	4,084	1.1	7.7	Petroleum	397	−47.1	7.6	9.7	3,265	7.8	12.2
12	12	Shell Oil	3,718	−3.0	15.2	Petroleum	519	−44.8	26.6	14.0	3,952	13.9	13.1
13	13	Eastman Kodak	3,588	1.9	19.0	Photo equipment	602	−6.4	21.2	16.8	3,952	16.4	15.2
14	15	W. R. Grace	3,570	10.8	52.9	Specialty chemicals	431	6.9	77.9	12.1	2,756	44.3	15.6
15	14	Chevron	3,325	9.1	8.0	Petroleum	44	−91.7	0.9	1.3	2,622	7.5	1.7
16	17	Arco Chemical	2,830	6.3	100.0	Basic chemicals	469	−19.1	100.0	16.6	3,739	100.0	12.5
17	18	Rohm & Haas	2,824	6.1	100.0	Basic chemicals	351	22.3	100.0	12.4	2,414	100.0	14.5
18	16	Allied-Signal	2,786	−6.9	22.6	Diversified	287	−19.2	39.3	10.3	1,896	18.1	15.1
19	19	Air Products[e]	2,614	5.3	90.3	Basic chemicals	441	3.6	108.0	16.9	3,132	80.3	14.1
20	21	Bayer USA	2,380	3.6	40.0	Diversified chemicals	91[f]	−24.9	61.2	3.8[f]	na	na	na
21	32	Rhône-Poulenc	2,278	42.4	100.0	Specialty chemicals	na	na	na	na	na	na	na
22	22	American Cyanamid	2,255	0.6	49.3	Basic chemicals	195	−15.0	62.2	8.7	1,832	36.0	10.7
23	23	Ashland Oil[e]	2,245	0.7	25.0	Petroleum	70	−45.3	21.1	3.1	856	16.7	8.2
24	30	Hercules	2,193	3.6	68.5	Basic chemicals	167	22.8	69.0	7.6	1,860	50.3	9.0
25	20	Phillips Petroleum	2,120	−13.4	15.6	Petroleum	448	−31.3	21.3	21.1	1,797	14.8	24.9
26	42	Ciba-Geigy	1,976	10.0	52.0	Specialty chemicals	na	na	na	na	na	na	na
27	24	Quantum Chemical	1,959	−6.9	73.8	Basic chemicals	242	−42.7	95.1	12.4	2,235	69.4	10.8
28	25	B. F. Goodrich	1,940	−1.9	79.7	Basic chemicals	129	−50.4	85.2	6.7	1,521	64.3	8.5
29	31	Akzo	1,893	1.0	100.0	Basic chemicals	152	11.6	100.0	8.0	na	na	na
30	26	Lyondell Petrochemical	1,889	19.6	29.1	Petroleum products	na	na	na	na	na	na	na
31	29	Alcoa	1,842[d]	5.7	17.2	Nonferrous metals	1319	11.5	121.3	71.6	2,855	25.0	46.2
32	27	Texaco	1,723	−5.2	4.1	Petroleum	60	−85.0	2.5	3.5	1,308	5.0	4.6
33	33	Dow Corning	1,718	9.1	100.0	Specialty chemicals	171[f]	5.1	100.0	10.0[f]	na	na	na
34	34	National Starch	1,670	6.4	100.0	Specialty chemicals	254	12.3	100.0	15.2	1,448	100.0	17.6
35	35	FMC	1,624	5.4	43.6	Machinery	192	−15.1	45.4	11.8	1,469	49.6	13.0
36	36	Ethyl	1,591	4.7	100.0	Basic chemicals	308	9.0	100.0	19.4	1,383	100.0	22.3
37	28	Atochem	1,540	−13.4	100.0	Basic chemicals	na	na	na	na	na	na	na
38	56	Degussa	1,435	61.9	75.3	Specialty chemicals	na	na	na	na	na	na	na
39	45	Lubrizol	1,335	18.8	91.9	Specialty chemicals	398	24.1	90.8	29.8	887	79.5	44.9
40	42	Huntsman Chemical	1,300	8.3	100.0	Basic chemicals	na	na	na	na	na	na	na
41	40	Tenneco	1,298	6.0	8.9	Diversified	167	40.3	11.5	12.9	1,409	7.5	11.9
42	38	Olin	1,269	−1.2	49.0	Basic chemicals	45	−74.1	30.6	3.5	945	50.6	4.8
43	39	Unocal	1,236	−3.1	10.5	Petroleum	115	−47.0	23.7	9.3	671	6.9	17.1
44	48	Nalco Chemical	1,212	13.2	100.0	Specialty chemicals	211	16.3	100.0	17.4	1,037	100.0	20.3
45	44	PPG Industries	1,150	−2.1	19.1	Glass products	231	−10.1	25.4	20.1	1,076	17.8	21.5
46	52	Cabot[e]	1,107	16.3	66.2	Basic chemicals	147	32.1	89.6	13.3	1,100	63.5	13.4
47	41	IMC Fertilizer[g]	1,106	−9.5	100.0	Agrochemicals	171	−33.5	100.0	15.5	1,585	100.0	10.8
48	61	Great Lakes Chemical	1,066	34.6	100.0	Specialty chemicals	290	43.7	100.0	27.2	1,406	100.0	20.6
49	67	Imcera Group[g]	1,025	54.7	71.9	Specialty chemicals	104	99.2	92.5	10.2	1,090	51.1	9.6
50	54	Morton International[g]	1,021	9.2	62.3	Specialty chemicals	140	−3.4	58.0	13.7	na	na	na

Rank 1990	Rank 1989		Chemical sales 1990 ($ millions)	Change from 1989	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1989	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
51	—	Reichhold Chemicals	$1000	na	100.0%	Specialty chemicals	na	na	na	na	na	na	na
52	50	Solvay America	997	0%	100.0	Basic chemicals	na	na	na	na	na	na	na
53	51	Aristech.	974	−2.2	100.0	Basic chemicals	na	na	na	na	na	na	na
54	55	Farmland Industries[h]	965	9.2	28.6	Agricultural supplies	$84	−7.0%	52.5%	8.7%	$412	30.4%	20.4%
55	57	International Flavors	963	10.7	100.0	Specialty chemicals	243	11.8	100.0	25.3	1129	100.0	21.5
56	53	Terra Chemicals	961	1.3	100.0	Agrochemicals	na	na	na	na	na	na	na
57	47	Georgia Gulf	932	−15.6	100.0	Basic chemicals	229	−23.6	100.0	24.5	457	100.0	50.1
58	49	NL Industries	907	−9.4	100.0	Basic chemicals	251	−18.6	100.0	27.7	1967	100.0	12.8
59	58	CF Industries	903	5.5	100.0	Agrochemicals	49	78.5	100.0	5.4	801	100.0	6.1
60	46	Freeport-McMoRan	825	−25.3	52.2	Agrochemicals	52	−52.3	17.2	6.3	880	24.5	5.9
61	66	American Petrofina	813	22.8	21.1	Petroleum	160	15.7	61.8	19.7	523	18.4	30.6
62	60	Uniroyal Chemical	808	0.4	100.0	Specialty chemicals	108	2.4	100.0	13.4	1178	100.0	9.2
63	59	Engelhard	807	−0.7	27.4	Diversified	100	3.8	71.0	12.4	874	66.2	11.4
64	65	H. B. Fuller[i]	792	5.2	100.0	Specialty chemicals	52	12.8	100.0	6.6	490	100.0	10.6
65	64	Witco	769[j]	0.4	47.1	Specialty chemicals	82	363.7	66.9	10.7	477	40.5	17.2
66	β2	Vista Chemical[e]	719	−7.7	100.0	Basic chemicals	151	−32.7	100.0	20.9	na	na	na
67	69	Kerr-McGee	642	8.4	17.4	Petroleum	123	−1.6	33.8	19.2	658	18.9	18.7
68	72	Betz Laboratories	597	15.5	100.0	Specialty chemicals	104	19.0	100.0	17.4	427	100.0	24.4
69	79	Loctite	555	17.2	100.0	Specialty chemicals	48	17.0	100.0	8.6	489	100.0	9.7
70	76	Merck	551	11.9	7.2	Drugs	68	14.5	2.6	12.3	510	6.4	13.3
71	74	Pfizer	548	7.5	6.5	Drugs	29	−26.2	2.5	5.3	418	4.6	6.9
72	77	Ferro	513	5.5	45.6	Specialty materials	10	−46.2	14.5	2.0	288	42.0	3.5
73	70	Sterling Chemical[e]	506	−12.9	100.0	Basic chemicals	88	−43.4	100.0	17.5	352	100.0	25.1
74	75	Hoffmann-La Roche	500	0	20.8	Drugs	na	na	na	na	na	na	na
75	63	Nova	489	−27.9	100.0	Basic chemicals	−17	def	100.0	def	221	100.0	def
76	73	Sun Co.	486	−4.6	3.7	Petroleum	na	na	na	na	na	na	na
77	68	GAF	481	−19.8	52.2	Specialty chemicals	164	−4.4	88.8	34.0	na	na	na
78	—	Hüls	465	3.6	100.0	Specialty chemicals	na	na	na	na	na	na	na
79	83	Union Camp	460	12.8	16.2	Diversified	22	66.2	6.1	4.9	352	8.0	6.4
80	84	Sigma-Aldrich	440	22.6	83.2	Specialty chemicals	104	14.3	94.1	23.5	485	88.7	21.4
81	81	Dexter	438	−0.1	48.3	Specialty chemicals	38	23.3	90.7	8.7	280	36.7	13.7
82	78	Borden Chemicals	421	−9.7	100.0	Basic chemicals	68	−29.1	100.0	16.1	544	100.0	12.4
83	82	Vulcan Materials	409	−4.9	37.0	Nonmetallic minerals	72	−16.2	39.3	17.7	na	na	na
84	85	Stepan	390	12.5	100.0	Specialty chemicals	21	83.1	100.0	5.5	247	100.0	8.7
85	87	Crompton & Knowles	311	10.7	79.7	Specialty chemicals	43	19.6	72.2	13.9	239	84.5	18.1
86	86	First Mississippi[g]	295	−4.1	59.3	Agrochemicals	23	−14.8	97.4	7.8	173	33.9	13.3
87	90	Calgon Carbon	285	12.4	100.0	Basic chemicals	62	10.1	100.0	21.9	285	100.0	21.9
88	89	Petrolite[k]	283	2.9	94.2	Specialty chemicals	17	−9.4	93.3	5.9	209	82.8	8.0
89	88	Chemed	275	−0.9	45.9	Specialty chemicals	23	−38.6	56.3	8.5	139	42.4	16.9
90	92	Mississippi Chemical[g]	253	21.1	100.0	Farm cooperative	5	−89.6	100.0	1.9	289	100.0	1.7
91	90	Georgia-Pacific	247	−2.4	2.0	Wood products	na	na	na	na	na	na	na
92	94	Quaker Chemical	201	10.9	100.0	Specialty chemicals	22	17.6	100.0	10.7	152	100.0	14.1
93	—	Sequa Corp.	201	42.4	10.8	Diversified	30	54.4	20.2	14.7	112	5.9	26.5
94	93	Sherex	177	−5.9	100.0	Specialty chemicals	na	na	na	na	na	na	na
95	98	Lawter International	150	10.3	100.0	Specialty chemicals	28	23.0	100.0	18.5	154	100.0	18.0
96	95	LeaRonal[i]	141	−10.5	100.0	Specialty chemicals	14	−10.4	100.0	10.0	81	100.0	17.3
97	99	Cambrex Corp.	134	2.0	100.0	Specialty chemicals	4	−32.3	100.0	3.3	na	na	na
98	97	Eagle-Picher	123	−19.4	17.5	Diversified	16	7.4	33.3	13.0	76	18.2	21.1
99	—	Aceto[e]	122	8.1	100.0	Specialty chemicals	7	−2.4	100.0	5.4	68	100.0	9.6
100	—	Sybron	120	na	100.0	Specialty chemicals	na	na	na	na	na	na	na

a Operating income is sales less administrative expenses and cost of sales. b Chemical operating profit as a percentage of sales. c Chemical operating profit as a percentage of identifiable chemical assets. d Chemical sales include significant amounts of nonchemical products. e Fiscal year ended Sept. 30. f Chemical net income. g Fiscal year ended June 30. h Fiscal year ended Aug. 31. i Fiscal year ended Nov. 30. j Does not include all chemical sales. k Fiscal year ended Oct. 31. l Fiscal year ended Feb. 28, 1990. na = not available. def = deficit.

FINANCIAL ANALYSIS: Decline evident in many chemical company performance measures

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES OVER $1 BILLION													
Air Products[g]	1990	7.9%	3.9%	36.1%	24.5%	35.5%	$207	33.4%	16.2%	18.8%	2.5%	74.2%	49.6%
	1989	8.4	4.3	37.1	23.6	30.8	187	31.2	15.7	18.7	2.7	78.5	49.9
American Cyanamid	1990	2.4	1.7	13.1	39.6	27.2	143	118.9	8.2	19.7	10.1	89.8	51.5
	1989	6.1	5.0	16.5	38.6	24.6	136	41.1	8.2	22.6	8.4	97.1	51.4
Cabot[g]	1990	4.2	3.4	45.7	41.8	36.0	279	41.8	10.4	19.9	2.1	96.6	57.3
	1989	0.9	1.0	44.1	32.8	12.7	352	166.1	9.9	25.9	1.8	136.7	56.1
Dow Chemical	1990	7.0	5.1	37.4	52.0	45.4	318	51.4	10.7	25.7	5.7	82.5	43.1
	1989	14.1	10.1	32.6	54.1	44.9	283	23.2	9.6	22.2	5.0	79.4	44.1
Ethyl	1990	9.2	12.5	39.5	21.2	4.9	441	108.0	6.0	22.4	2.6	37.6	50.8
	1989	14.4	13.2	35.6	31.3	3.8	276	26.3	7.8	20.5	4.0	27.0	48.8
B. F. Goodrich	1990	4.8	4.3	13.2	24.7	18.6	165	53.8	10.0	21.9	3.0	102.8	60.3
	1989	7.1	6.3	18.5	26.7	18.6	203	34.6	9.9	24.2	2.7	106.4	59.6
W. R. Grace	1990	3.0	2.8	50.7	36.9	34.1	138	59.5	7.6	20.9	2.2	108.5	50.2
	1989	4.2	3.9	48.6	34.8	31.0	132	46.6	7.9	21.8	2.0	108.8	49.6
Great Lakes Chemical	1990	13.2	11.5	9.2	53.1	42.7	na	11.5	4.6	13.3	2.7	75.8	59.5
	1989	15.5	13.2	16.1	40.1	49.6	na	11.1	5.1	14.7	3.4	72.2	56.6
Hercules	1990	3.0	2.4	23.6	27.8	18.6	161	109.4	8.5	18.8	2.9	86.5	47.3
	1989	def	def	23.3	25.4	17.0	133	def	9.5	20.7	2.5	84.6	48.4
Imcera Group	1990	4.1	3.7	47.8	34.4	17.0	133	def	9.5	20.7	2.5	84.6	48.4
	1989	11.2	7.1	44.5	25.8	27.3	148	43.8	6.0	14.6	5.3	66.9	69.2
Lubrizol	1990	13.2	12.2	6.8	56.8	43.7	280	27.5	5.4	21.9	5.2	129.6	39.0
	1989	7.7	6.9	7.4	52.4	40.3	230	54.8	5.3	20.4	5.7	127.1	39.0
Monsanto	1990	6.1	4.9	28.8	36.8	32.4	219	44.3	8.3	21.5	7.7	97.4	45.8
	1989	7.8	6.7	27.2	35.6	28.5	206	32.5	7.0	19.1	6.9	100.9	45.7
Morton International[h]	1990	8.2	7.4	20.6	30.4	25.6	169	30.7	6.8	17.2	2.9	90.4	59.7
	1989	6.9	6.5	4.6	31.1	26.4	167	na	9.4	23.8	2.7	103.1	59.7
Nalco Chemical	1990	10.8	10.5	38.3	28.2	20.4	207	48.2	9.5	27.4	3.7	116.9	49.5
	1989	11.2	10.8	32.5	27.1	19.4	195	47.9	8.1	24.6	3.8	114.1	48.7
Olin	1990	3.2	2.8	39.5	7.8	10.9	171	58.3	7.2	22.6	2.5	138.9	36.1
	1989	4.9	4.2	36.1	7.2	9.3	163	34.7	5.7	18.2	2.6	131.8	36.0
PPG Industries	1990	7.9	5.8	31.1	34.3	33.5	172	37.0	6.9	12.8	3.6	98.6	54.3
	1989	8.1	6.2	33.3	30.9	29.7	162	35.6	9.4	17.9	4.1	101.6	55.2
Quantum	1990	0.8	0.6	104.2	na	na	na	0	17.3	22.7	1.8	82.4	69.5
	1989	4.3	3.4	107.9	na	na	na	1121.1	21.8	33.2	1.7	88.9	70.0
Rohm & Haas	1990	7.3	5.5	32.7	43.7	32.4	219	38.2	14.6	29.6	6.3	104.5	50.2
	1989	6.6	5.2	21.5	43.2	32.1	204	43.8	14.5	33.5	6.6	108.4	47.9
Union Carbide	1990	4.0	2.6	49.6	36.4	32.3	202	44.8	9.8	17.2	2.5	87.3	48.5
	1989	6.6	4.7	46.6	33.7	40.7	190	24.4	9.0	17.1	2.1	102.3	48.1
Witco	1990	4.2	4.4	28.2	19.8	20.2	225	56.4	5.6	19.3	1.6	138.4	48.8
	1989	2.2	2.3	29.2	18.9	16.4	216	103.3	4.4	16.9	1.6	139.4	48.3
MEDIAN 1990		5.5%	4.4%	34.4%	34.4%	32.3%	$205	44.6%	8.3%	20.4%	2.9%	93.5%	50.2%
MEDIAN 1989		7.0	5.7	32.6	31.3	26.4	193	34.7	8.7	20.6	3.1	102.0	49.2

2 Finances of the U.S. Chemical Industry

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES LESS THAN $1 BILLION													
Betz Laboratories	1990	11.0%	11.3%	31.0%	19.0%	22.0%	$162	56.2%	9.6%	24.6%	3.9%	139.7%	57.9%
	1989	10.8	12.1	35.2	17.8	18.9	151	55.4	10.2	30.7	3.7	139.9	54.6
Calgon Carbon	1990	13.9	12.4	5.3	39.2	43.5	190	15.4	16.7	33.0	2.0	99.9	76.4
	1989	13.9	13.3	9.9	37.3	30.7	191	12.5	10.4	25.8	1.9	108.4	75.5
Chemed	1990	3.1	6.3	42.2	12.2	13.7	87	122.4	2.5	19.7	0.6	161.7	55.2
	1989	4.9	9.8	41.5	11.0	11.8	93	70.6	2.7	21.4	0.6	158.1	56.5
Crompton & Knowles	1990	7.7	10.4	37.4	18.7	19.2	218	31.2	4.2	21.3	2.2	138.0	62.1
	1989	6.9	11.2	29.4	17.3	21.5	212	27.9	3.8	26.4	2.2	163.3	56.1
First Mississippi[h]	1990	0.9	0.5	39.7	24.0	na	na	135.0	13.0	20.8	na	97.2	45.0
	1989	3.8	2.1	30.6	17.7	na	na	34.6	24.7	38.2	na	90.8	44.8
H. B. Fuller[i]	1990	2.7	3.7	30.9	46.3	54.2	142	25.7	4.0	15.6	2.0	161.9	61.3
	1989	2.1	3.1	35.1	44.9	50.8	140	34.9	5.4	21.9	2.1	165.5	63.5
Georgia Gulf	1990	10.2	17.9	263.9	na	na	868	0	6.2	27.1	na	204.1	68.0
	1989	17.4	35.3	66.1	na	na	818	12.5	4.9	25.9	na	233.5	69.7
International Flavors	1990	16.3	11.4	0.0	70.1	46.6	230	52.5	4.3	15.5	6.0	85.3	51.7
	1989	15.9	11.9	0.0	69.2	47.0	206	52.6	3.8	14.1	6.0	89.7	53.1
Loctite	1990	12.1	13.0	9.8	55.0	65.5	151	31.2	5.1	27.4	3.9	113.5	55.6
	1989[h]	11.9	14.0	13.8	57.9	62.0	130	26.4	3.5	22.8	3.8	126.1	53.7
Petrolite[j]	1990	4.4	3.4	2.3	31.3	37.5	na	96.7	5.8	14.8	4.1	118.9	44.5
	1989	2.4	2.0	1.1	30.5	35.0	na	178.1	6.5	18.0	4.1	121.5	44.0
Quaker	1990	7.0	8.4	5.2	41.1	35.0	187	30.5	6.3	27.3	na	132.2	55.3
	1989	7.1	8.9	5.9	43.4	32.1	185	29.8	4.2	20.7	na	138.2	53.0
Sigma-Aldrich	1990	13.5	11.3	16.1	28.1	29.0	129	14.3	6.1	16.9	na	96.9	66.2
	1989	14.5	12.0	17.1	21.9	26.4	116	14.3	11.7	29.3	na	93.4	71.3
Stepan	1990	3.7	3.8	48.3	11.7	13.6	297	22.0	9.8	26.8	3.4	157.7	49.6
	1989	2.3	2.3	49.2	na	na	301	37.2	9.8	27.8	2.9	160.8	48.7
Sterling Chemical[g]	1990	11.7	14.8	37.1	35.4	na	na	93.6	3.9	9.2	na	143.8	78.8
	1989	17.9	28.6	37.6	35.0	na	na	42.5	9.9	26.6	na	176.5	84.7
MEDIAN 1990		10.2%	10.4%	16.1%	33.4%	33.6%	$189	31.2%	5.8%	21.3%	3.0%	132.2%	55.6%
MEDIAN 1989		10.8	11.2	29.4	35.0	32.1	188	34.9	5.4	25.8	2.8	138.2	54.6

Note: Net income is from continuing operations, excluding extraordinary and nonrecurring items where possible. **a** Net income as a percentage of sales. **b** Net income as a percentage of current assets plus gross plant. **c** Consolidated sales only. **d** Foreign identifiable assets as a percentage of total assets. **e** Thousands of dollars. **f** Actual spending on construction of new facilities and purchase of land and new equipment in consolidated businesses. **g** Fiscal year ended Sept. 30. **h** Fiscal year ended June 30. **i** Fiscal year ended Nov. 30. **j** Fiscal year ended Oct. 31. **na** = not available. **def** = deficit.

Chemical capital spending continues to rise

Capital spending by U.S. chemical producers continued to rise in 1990. In a year when earnings and profitability were both down, the 25 major chemical firms that C&EN tracks still increased their capital spending budgets a healthy 12% over already respectable 1989 spending levels.

The 1990 hike is much lower than the 23% increase in capital spending that these companies posted in 1989 or the 29% hike of 1988. Nevertheless, it's a good deal higher than the 4% annual compound growth rate during the past 10 years for the companies whose plant outlays are tabulated by C&EN.

As a percentage of sales, capital spending by the 25 companies continued to rise in 1990, reaching 10.6% and making 1990 the first year since 1982 when this figure topped 10%. Capital spending as a percentage of sales in 1989 was 9.9%. For much of the mid-1980s this value hovered around 8%.

The Department of Commerce's much wider survey of the chemical industry found a similar rise in capital expenditures in 1990. Their measure was up 11%. And, as of the first quarter of 1991, chemical companies planned to continue increasing capital spending in 1991, according to Commerce Department data. Plans for 1991 called for a 5% increase in capital outlays to reach $21.6 billion this year.

A separate survey by the Conference Board, meanwhile, shows that the backlog of unspent funds ticketed for plant expansions by chemical

INDUSTRY CAPITAL SPENDING: Holding steady for 1991 following three years of big gains

$ Billions	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Chemicals	$ 21.63	$ 20.54	$ 18.47	$ 19.25	$ 16.42	$ 16.81	$ 16.44	$ 15.32	$ 12.96	$ 12.66	$ 13.11
Iron and steel	7.20	7.81	7.87	6.16	4.69	3.32	4.12	3.54	3.25	3.78	3.48
Nonferrous metals	2.88	2.88	2.64	2.77	2.16	1.93	1.88	2.13	1.74	1.90	2.51
Paper	13.10	16.72	15.58	11.23	9.01	8.77	8.59	7.21	5.92	5.60	6.11
Petroleum	38.45	34.46	30.08	19.93	17.12	17.92	26.71	25.53	23.14	26.39	25.98
Rubber	3.44	3.48	3.79	3.86	3.52	3.89	3.86	3.11	2.46	2.16	2.15
Stone, clay, glass	3.19	3.31	4.00	3.59	3.37	3.14	3.40	3.09	2.77	2.90	3.41
All manufacturing	193.39	192.78	183.80	165.70	145.90	142.69	153.48	138.82	116.20	120.68	126.54

a Estimate. **Source:** Department of Commerce

Chemicals and petroleum sectors lead industry in unspent capital appropriations

$ Billions	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Chemicals	$ 12.6	$ 11.9	$ 10.6	$ 7.0	$ 6.2	$ 8.0	$ 7.8	$ 7.5	$ 7.4	$ 9.4	$ 9.8
Iron and steel	2.4	2.9	2.7	1.4	0.5	1.1	2.1	2.2	2.7	5.4	3.9
Nonferrous metals	2.1	2.3	1.6	1.7	1.6	2.3	2.5	3.2	3.2	3.7	3.7
Paper	14.6	17.4	12.3	6.3	4.4	4.3	5.9	4.0	5.1	5.1	4.0
Petroleum	23.4	17.1	14.6	15.2	16.7	26.2	24.7	22.3	22.9	29.7	26.7
Rubber	3.9	3.5	2.8	1.7	1.9	3.1	1.6	1.1	1.0	0.9	1.0
Stone, clay, glass	2.5	2.7	2.8	2.4	1.6	2.0	2.2	1.5	1.6	1.9	2.0
All manufacturing	106.3	114.2	101.7	76.8	69.7	95.0	94.4	73.7	70.8	92.7	91.9

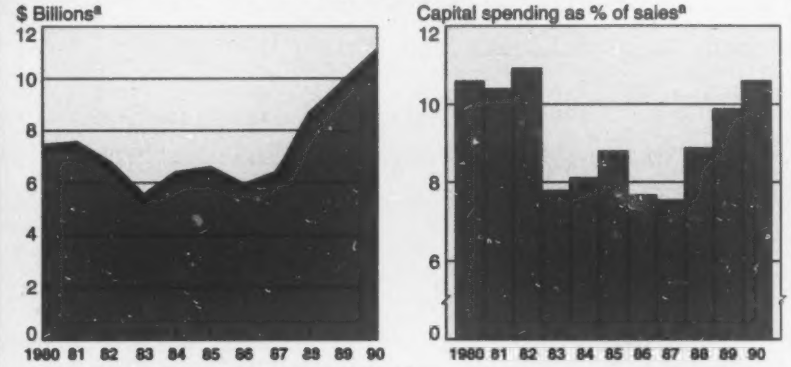
Note: Figures are for fourth quarter of each year. **Source:** Conference Board

Capital spending by chemical firms abroad continues to rise strongly

$ Billions[a]	1991[b]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Chemicals and allied products	$ 6.6	$ 6.2	$ 5.3	$ 4.7	$ 3.7	$ 3.1	$ 2.7	$ 2.4	$ 2.3	$ 2.8	$ 3.0
Metals, primary and fabricated	1.3	2.1	1.5	1.1	0.8	0.9	0.9	1.0	0.9	0.9	0.8
Petroleum	18.6	1.56	14.4	13.3	9.8	9.6	13.7	14.1	15.9	19.7	15.8
All manufacturing	29.8	27.4	23.4	20.8	17.2	16.4	14.9	13.6	13.6	16.8	19.2

a By majority-owned affiliates of U.S. companies. b Planned. **Source:** Department of Commerce

Chemical capital spending has more than doubled since 1983, and continues to grow faster than sales



a Worldwide data for 25 major chemical producers. **Source:** Company data

producers was 6% higher at the end of 1990 than a year earlier, rising to nearly $13 billion.

The hectic rate of increase in capital spending abroad by U.S. chemical companies continued in 1990, though Commerce Department data suggest the pace will slow in 1991. Overseas affiliates of U.S. chemical producers increased their outlays 17% in 1990, compared with a 13% rise in 1989. For 1991, they plan only a 6% rise in overseas expenditures.

CHEMICAL CAPITAL SPENDING: Tops $11 billion in third straight year of strong growth

$ Millions	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Air Products	$ 468	$ 414	$ 409	$ 323	$ 367	$ 392	$ 263	$ 246	$ 347	$ 323	$ 364
American Cyanamid	376	398	374	268	263	203	200	165	171	181	196
Cabot[a]	298	233	214	83	80	184	505	80	152	194	137
Chemed	13	14	15	9	9	7	9	5	4	4	4
Crompton & Knowles	16	13	7	4	4	3	3	2	3	7	10
Dow Chemical	2,119	1756	1264	995	890	806	781	630	829	1176	1184
Du Pont[b]	3,142	2563	2029	1674	1587	1515	1319	1276	1300	1420	1297
Ethyl	166	119	151	139	134	90	103	85	92	141	156
B. F. Goodrich	243	240	181	143	144	202	153	115	144	205	184
W. R. Grace	514	485	418	243	199	348	380	353	560	657	658
Great Lakes Chemical	49	40	47	35	18	21	29	20	29	47	21
Hercules	273	293	251	205	257	234	218	168	174	167	229
Loctite	29	24	15	17	11	9	10	9	9	11	14
Lubrizol	77	65	55	42	41	40	30	25	52	75	92
Monsanto	750	607	590	505	520	645	614	560	673	668	781
Nalco Chemical	115	86	62	57	64	60	53	41	56	59	35
Olin	187	142	147	115	128	154	165	123	129	186	172
PPG Industries	415	537	410	426	356	452	315	450	452	376	401
Petrolite	18	19	20	19	25	24	11	9	24	15	17
Quaker Chemical	13	8	5	4	5	6	4	2	2	1	5
Quantum Chemical	459	589	334	154	102	76	116	71	66	44	49
Rohm & Haas	412	385	338	222	179	159	124	72	126	182	93
Stepan	38	34	20	26	14	19	12	10	16	12	9
Union Carbide	744	726	608	452	466	649	670	761	1179	1186	1129
Witco	91	70	72	69	60	76	85	55	54	83	73
TOTAL	**$11,025**	**$9860**	**$8036**	**$6229**	**$5923**	**$6374**	**$6172**	**$5333**	**$6643**	**$7420**	**$7310**
ANNUAL CHANGE	**12%**	**23%**	**29%**	**5%**	**7%**	**3%**	**16%**	**−20%**	**−10%**	**2%**	**25%**

Note: Figures are for worldwide spending on construction, equipment, and land in consolidated businesses. Where possible, acquisition costs and investments in nonconsolidated businesses are excluded. a Includes acquisitions and investments. b Excludes Conoco. **Source:** Company data

2 Finances of the U.S. Chemical Industry

SHIPMENTS: Like all manufacturing, chemical products make modest gains in 1990

$ Billions	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
All manufacturing industries	$2860.3	$2781.4	$2611.6	$2390.0	$2260.3	2279.1	$2254.4	$2054.9	$1960.2	$2017.5	$1852.7	3%	4%
Chemicals and allied products	265.7	255.5	240.5	212.7	197.1	197.3	198.2	183.2	170.7	180.5	162.5	4	5
Industrial chemicals[a]	70.4	68.9	67.8	59.5	54.1	59.6	61.5	56.6	53.2	62.7	57.3	2	2
Drugs, soap, and toiletries	87.3	82.0	73.1	67.1	65.8	60.9	57.5	54.4	50.7	46.9	41.9	6	8
Petroleum and coal products	169.6	138.5	124.2	124.5	124.9	179.1	189.0	192.6	208.9	224.1	198.7	22	−2
Rubber and plastic products	90.1	95.8	91.1	80.5	73.4	71.3	69.5	60.3	55.4	53.2	47.3	−6	7
Paper and allied products	131.2	130.4	124.2	110.3	97.9	93.4	94.8	84.6	79.9	80.2	72.8	1	6

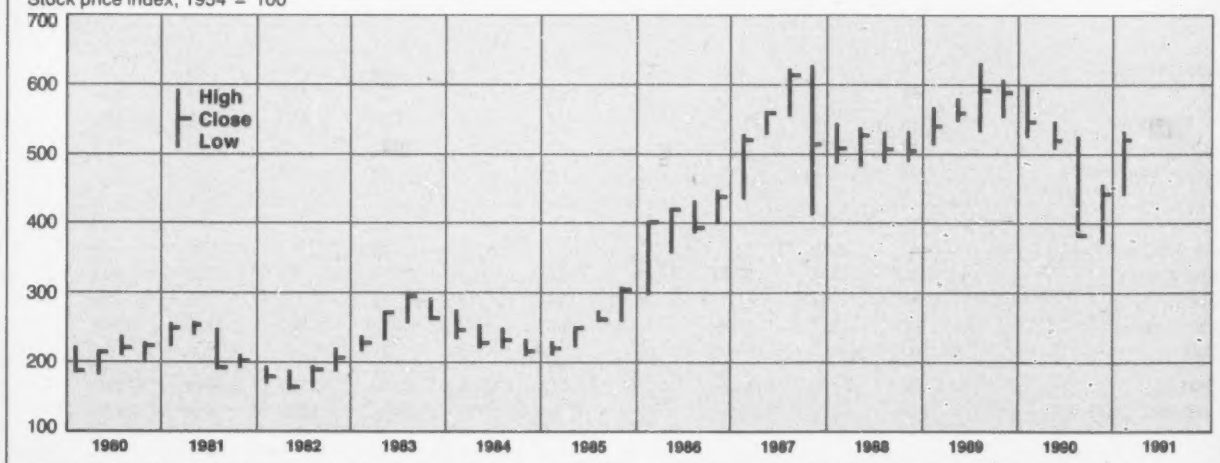
a Excluding pigments. **Source:** Department of Commerce

PRICES: Chemical products stagnated while other commodities rose last year

Producer price indexes, 1982 = 100	Annual average 1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
All commodities	116.3	112.2	106.9	102.8	100.2	103.1	103.7	101.3	100.0	98.0	89.8	4%	3%
Industrial commodities	115.8	111.6	106.3	102.6	99.9	103.7	103.3	101.1	100.0	97.4	88.0	4	3
Finished goods	119.2	113.6	108.0	105.4	103.2	104.7	103.7	101.6	100.0	96.1	88.0	5	3
Chemicals and allied products	123.6	123.0	116.3	106.4	102.5	103.7	102.9	100.2	100.0	98.4	89.1	0	3
Industrial chemicals	113.2	114.8	106.8	95.5	91.5	96.0	96.8	97.3	100.0	103.0	91.9	−1	2
Prepared paint	124.8	119.5	112.2	108.1	107.0	105.3	103.7	100.7	100.0	95.0	89.5	4	3
Paint materials	136.3	129.1	115.7	107.3	104.4	109.5	108.2	100.3	100.0	98.5	89.9	6	4
Drugs and pharmaceuticals	170.8	160.0	148.4	139.1	129.9	122.2	114.2	107.7	100.0	92.1	83.1	7	7
Fats and oils, inedible	88.1	95.5	110.9	92.7	80.5	110.6	139.1	106.2	100.0	110.7	111.6	−8	−2
Agricultural chemicals and chemical products	107.4	108.7	104.5	96.4	94.2	96.2	97.4	96.0	100.0	97.5	87.9	−1	2
Plastic resins and materials	124.1	133.4	132.4	110.3	104.4	107.5	108.9	102.4	100.0	102.0	98.5	−7	2
Other chemicals and allied products	118.9	117.3	111.9	107.0	105.8	105.2	102.7	101.3	100.0	94.1	83.1	1	4
Rubber and plastic products	113.6	112.6	109.3	103.0	101.9	101.9	102.2	100.8	100.0	96.4	90.1	1	2

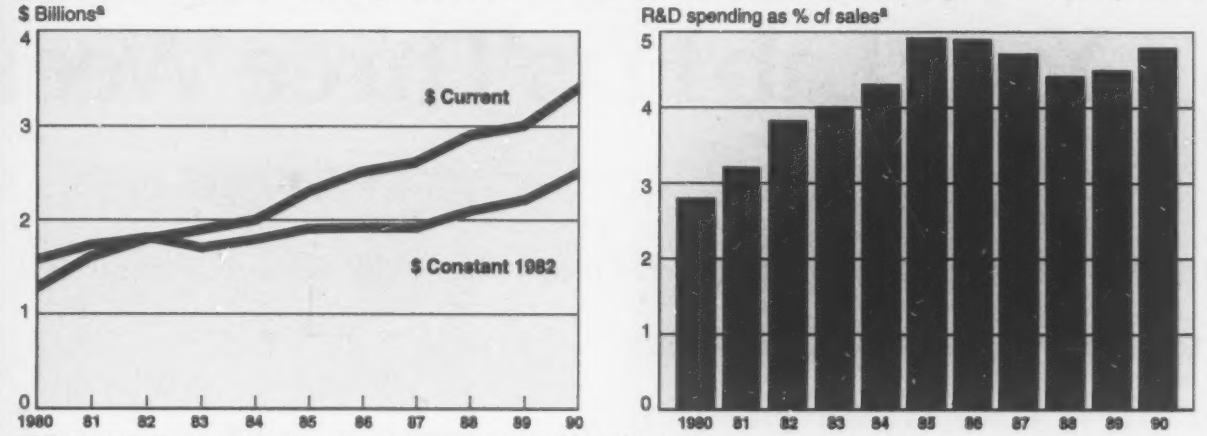
Source: Department of Labor

Chemical shares have partially recovered from deep plunge in mid-1990



a C&EN stock price index of American Cyanamid, Dow Chemical, W. R. Grace, Hercules, Monsanto, Rohm & Haas, and Union Carbide, weighted according to number of shares outstanding for each company.

R&D spending made healthy rise in 1990 in real terms and as a percentage of company sales



a R&D spending by 15 major chemical producers. **Sources:** Company data, Battelle Columbus Laboratories

R&D SPENDING: Most companies made significant increases in 1990

$ Millions	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
CHEMICAL COMPANIES											
Air Products[a]	$ 72	$ 71	$ 72	$ 57	$ 61	$ 51	$ 44	$ 40	$ 37	$ 32	$ 30
American Cyanamid	460	406	365	314	278	251	232	208	185	166	148
Dow Chemical	1136	873	772	670	605	547	507	492	460	404	314
Ethyl	65[b]	61[b]	59[b]	50	47	47	40	39	39	37	34
W. R. Grace	148	125	119	107	94	92	81	73	64	57	45
Hercules	92	79	74	74	71	76	72	74	74	65	57
International Flavors	57	52	50	45	39	34	32	32	31	30	29
Lubrizol	74	70	65	62	51	44	33	37	36	33	28
Monsanto	612	598	648	615	596	470	370	290	264	233	208
Nalco	45	41	37	35	33	32	32	30	33	30	28
Olin	66	66	58	62	56	53	52	49	45	38	31
Petrolite	12	12	12	12	12	12	12	13	10	8	7
PPG Industries	218	233	232	227	204	176	150	127	127	119	103
Rohm & Haas	178	175	156	142	133	124	109	100	92	77	67
Union Carbide	191	181	159	159	148	275	265	245	240	207	166
TOTAL	**$3426**	**$3043**	**$2867**	**$2631**	**$2428**	**$2284**	**$2031**	**$1849**	**$1737**	**$1536**	**$1295**
ANNUAL CHANGE	**13%**	**6%**	**9%**	**8%**	**6%**	**12%**	**10%**	**6%**	**13%**	**19%**	**17%**
PHARMACEUTICAL & DIVERSIFIED COMPANIES											
Allied-Signal[c]	$ 721	$ 603	$ 647	$ 667	$ 734	$ 470	$ 389	$ 383	$ 177	$ 152	$ 105
Du Pont	1428	1387	1319	1223	1156	1144	1097	966	879	718	591
Eastman Kodak	1329	1253	1147	992	1059	976	838	746	710	615	520
Eli Lilly	703	605	512	466	427	370	341	294	267	235	201
FMC	158	150	144	132	146	149	121	102	105	94	81
Merck & Co.	854	751	669	566	480	426	393	356	320	274	234
Morton International[c,d]	48	38	35	31	29	34	28	21	7	6	6
Pfizer	640	531	473	401	336	287	255	230	199	179	162
Upjohn	427	407	380	356	314	284	247	218	185	162	139
TOTAL	**$6308**	**$5725**	**$5326**	**$4834**	**$4681**	**$4140**	**$3709**	**$3316**	**$2849**	**$2435**	**$2039**
ANNUAL CHANGE	**10%**	**7%**	**10%**	**3%**	**13%**	**12%**	**12%**	**16%**	**17%**	**19%**	**17%**

Note: Prior years not restated to reflect company revisions. a For fiscal year ending Sept. 30. b Adjusted to reflect spin-off of Tredegar Industries. c Includes all company-financed R&D but excludes contract R&D. d Fiscal year ends June 30; data for Morton Thiokol prior to 1985. **Source:** Company data

INDUSTRY BALANCE SHEET: Liabilities, particularly long-term debt, show greatest rise

Industrial chemicals and synthetics

Assets	1990 ($ billions)	1989 ($ billions)	Change
Current assets			
Cash	$ 1.20	$ 1.66	−28%
Short-term securities	1.10	1.41	−22
Receivables	18.45	16.77	10
Inventories	14.51	13.91	4
Other current assets	4.57	3.87	18
Total	**39.82**	**37.62**	**6**
Fixed assets			
Depreciable fixed assets	99.20	91.06	9
Land and mineral rights	8.16	2.96	146
Less: accumulated depreciation and depletion	51.01	47.42	8
Net fixed assets	**56.35**	**46.61**	**21**
Other assets, including investments and intangibles	**39.82**	**36.53**	**9**
TOTAL ASSETS	**$135.99**	**$120.76**	**13%**

Liabilities and stockholders' equity	1990 ($ billions)	1989 ($ billions)	Change
Current liabilities			
Short-term debt	$ 6.02	$ 4.85	24%
Accounts payable	9.24	8.49	9
Accrued income taxes	1.38	1.27	9
Current portion of long-term debt	1.46	1.87	−22
Other current liabilities	11.49	10.06	14
Total	**29.59**	**26.54**	**11**
Long-term debt	**33.05**	**27.23**	**21**
Other liabilities, including deferred taxes and minority interest	**14.92**	**12.26**	**22**
TOTAL LIABILITIES	**77.55**	**66.02**	**17**
Stockholders' equity			
Capital stock and other capital	19.10	16.37	17
Retained earnings	39.34	38.37	3
TOTAL STOCKHOLDERS' EQUITY	**58.44**	**54.74**	**7**
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	**$135.99**	**$120.76**	**13%**

Source: Bureau of the Census

DEBT RATIOS: High levels of recent years show no signs of abatement

$ Billions	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
INDUSTRIAL CHEMICALS AND SYNTHETICS											
Long-term debt	$ 33.1	$ 29.4	$ 28.5	$ 28.3	$ 20.8	$ 19.2	$ 18.1	$ 19.4	$ 22.0	$ 21.4	$ 16.8
Stockholders' equity	$ 58.4	$ 56.6	$ 51.7	$ 45.3	$ 41.6	$ 40.8	$ 46.5	$ 45.3	$ 45.9	$ 42.5	$ 39.8
Debt ratio[a]	36.2%	34.2%	35.6%	38.4%	33.4%	32.0%	28.0%	30.0%	32.4%	33.5%	29.6%
CHEMICALS AND ALLIED PRODUCTS											
Long-term debt	$ 74.5	$ 64.2	$ 58.9	$ 53.6	$ 46.8	$ 38.2	$ 33.8	$ 36.2	$ 38.2	$ 36.9	$ 28.3
Stockholders' equity	$ 138.6	$ 127.1	$120.5	$106.9	$100.8	$100.3	$100.3	$ 97.2	$ 95.3	$ 89.9	$ 79.5
Debt ratio[a]	35.0%	33.5%	32.8%	33.4%	31.7%	27.6%	25.2%	27.2%	28.6%	29.1%	26.3%
ALL MANUFACTURING											
Long-term debt	$ 623.0	$ 594.9	$535.4	$451.7	$407.5	$367.0	$324.2	$286.6	$293.1	$266.5	$236.2
Stockholders' equity	$1051.2	$1006.3	$979.9	$912.8	$878.1	$870.7	$883.6	$837.6	$783.0	$762.3	$699.7
Debt ratio[a]	37.2%	37.2%	35.3%	33.1%	31.7%	29.6%	26.8%	25.5%	27.2%	25.9%	25.2%

Note: Because of the changes in accounting rules and industry classifications, numbers over the entire range of years are not strictly comparable. a Long-term debt as a percentage of long-term debt plus stockholders' equity. **Source:** Bureau of the Census

CASH FLOW: With profits down, companies used working capital to finance efforts last year

$ Millions, % of total	1990		1989		1988		1987		1986	
SOURCES OF FUNDS										
Net income	$ 6,007	23.8%	$ 7,621	29.2%	$ 7,696	39.2%	$ 5,749	29.8%	$ 3,395	13.4%
Depreciation and depletion	6,596	26.2	6,108	23.4	5,602	28.6	5,311	27.6	5,157	20.3
Deferred taxes	660	2.6	156	0.6	302	1.5	304	1.6	555	2.2
Other internal sources	4,248	16.9	3,355	12.8	2,164	11.0	4,257	22.1	6,378	25.1
Long-term debt	7,152	28.4	8,125	31.1	3,619	18.4	2,893	15.0	8,732	34.4
Stock	535	2.1	753	2.9	236	1.2	759	3.9	1,199	4.7
TOTAL	**$25,196**	**100.0%**	**$ 26,118**	**100.0%**	**$19,622**	**100.0%**	**$19,273**	**100.0%**	**$25,416**	**100.0%**
APPLICATIONS OF FUNDS										
Dividends	$ 2,992	11.9%	$ 2,602	10.0%	$ 2,308	11.8%	$ 2,196	11.4%	$ 1,994	7.8%
Capital expenditures	11,614	46.1	10,017	38.4	9,125	46.5	6,525	33.9	6,076	23.9
Additions to working capital	901	3.6	−1,714	−6.6	756	3.9	2,868	14.9	−437	−1.7
Reduction of long-term debt	3,701	14.7	5,529	21.2	3,107	15.8	2,649	13.7	7,801	30.7
Other applications	5,988	23.7	9,685	37.1	4,326	22.0	5,035	26.1	9,982	39.3
TOTAL	**$25,196**	**100.0%**	**$ 26,118**	**100.0%**	**$19,622**	**100.0%**	**$19,273**	**100.0%**	**$25,416**	**100.0%**

Note: Data are totals for 12 major chemical producers: American Cyanamid, Dow Chemical, Du Pont, Ethyl (excludes insurance business), B. F. Goodrich, W. R. Grace, Hercules, Monsanto, Olin, Quantum Chemical, Rohm & Haas, and Union Carbide. **Sources:** Company annual reports

Explanation of company results table headings

Year. Data are for calendar year unless otherwise indicated.

Net sales. Gross sales, less discounts, allowances, and returns; generally excludes excise taxes and other operating income or revenues.

Net income. Net sales and other income, less operating costs, nonoperating charges, depreciation, depletion, interest expense, deferred charges, minority interest in income, and taxes. Nonrecurring or extraordinary credits and charges have been excluded in most cases, but are footnoted.

Total assets. Sum at year's end of current assets, investments, prepaid expenses, net plant and equipment, and other tangible assets. Excludes insofar as possible intangible assets including goodwill, value of patents, and the like.

Current ratio. The ratio of current assets (cash, marketable securities, receivables, inventories, and prepaid expenses) to total current liabilities.

Net plant and equipment. Value at year's end of fixed assets, less accumulated depreciation, amortization, and depletion.

Capital expenditures. Total spending during the year for new fixed assets, such as plant, equipment, and land, and for replacement and modernization of facilities.

Stockholders' equity. Equity at year's end of preferred and common stockholders, including value of capital stock, capital and earned surplus, and surplus reserves, as well as contingency and miscellaneous reserves for which no definite purpose is stated. Intangible assets are deducted insofar as possible.

Net income. (breakdown). **Percent of sales:** net income divided by net sales. **Percent of net worth:** net income divided by tangible net worth. **Dollars per share:** net income, less preferred dividends, divided by the number of shares of common stock outstanding. All figures are adjusted for stock splits, but no adjustment has been made for earlier years as a result of stock dividends or for dilution that might result from the conversion of preferred stock or debt to common stock or the exercise of stock options outstanding.

Dividends per share. Cash dividends paid (or declared) on each share of common stock; excludes the value of stock dividends, which are indicated by a footnote.

Dividend yield. Dividends per share divided by the average of the high and low prices of the common stock during the calendar year.

Stock price range. High-low market prices of common stock during the year, adjusted for stock splits but not for stock dividends.

Price-earnings ratio. Average of the high and low prices of the common stock during the calendar year divided by net income per share.

COMPANY RESULTS: Almost half of chemical and all drug companies boosted earnings last year

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME: % of sales	NET INCOME: % of stockholders' equity	NET INCOME: $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
	(Money figures in thousands of dollars unless otherwise indicated)													
CHEMICALS														
Air Products & Chemicals														
1990[a]	$2,894,700	$229,900	$3,844,800	1.2	$2,485,100	$467,500	$1,633,700	7.9%	14.1%	$4.15	$1.38	2.7%	$61–43	12.5
1989[a]	2,641,823	222,137	3,313,343	1.4	2,217,594	413,735	1,392,534	8.4	16.0	4.04	1.26	2.9	48¾–37¼	10.7
1988[a]	2,431,866	213,747	2,962,295	1.1	2,061,642	386,907	1,235,027	8.8	17.3	3.90	1.10	2.7	53½–29	10.6
1987[a]	2,132,176	159,668[b]	2,695,625	1.2	1,920,520	312,712	1,140,512	7.5	14.0	2.83[b]	0.90	2.0	53⅞–35⅛	15.6
American Cyanamid Co.														
1990	$4,570,200	$107,800[c]	$4,864,000	1.5	$1,906,000	$375,500	$2,334,700	2.4%	4.6%	$1.15[c]	$1.35	2.2%	$61½–42	5.3
1989	4,825,000	292,000	4,719,800	1.4	1,757,000	397,600	2,070,000	6.1	14.1	3.12	1.31	2.5	60⅝–45⅝	17.0
1988	4,592,000	305,600	4,332,200	1.4	1,556,800	373,800	1,801,100	6.7	17.0	3.41	1.16	2.4	56–41⅞	14.4
1987	4,186,100	264,000[d]	3,878,400	1.5	1,391,900	268,100	1,622,400	6.3	16.3	2.89[d]	1.025	2.4	57–29	14.9
Arco Chemical Co.														
1990	$2,950,000	$351,000	$3,739,000	2.6	$1,768,000	$539,000	$1,758,000	11.9%	20.0%	$3.66	$2.50	6.6%	$44¼–29¾	10.1
1989	2,663,000	405,000	2,655,000	2.0	1,263,000	262,000	1,591,000	15.5	25.5	4.22	2.125	6.1	40⅝–28¾	8.2
1988	2,700,000	494,000	2,548,000	1.8	1,078,000	214,000	1,375,000	18.3	35.9	5.00	0.85	2.8	38–23¼	6.1
1987[e]	1,952,000	257,000	2,534,000	1.3	984,000	290,000	1,116,000	13.2	23.0	2.58[f]	0.20	0.7	38¾–17	10.8
Betz Laboratories														
1990	$596,805	$65,474	$420,589	2.3	$233,451	$57,540	$213,936	11.0%	30.6%	$2.12	$1.01	2.7%	$43¼–30¾	17.5
1989	516,669	55,860	358,743	2.6	201,464	52,952	172,971	10.8	32.3	1.76	0.89	3.2	31⅛–23⅝	15.5
1988	447,580	48,385	307,862	1.9	174,970	43,505	219,901	10.8	22.0	3.15	1.60	3.4	52½–41¼	14.9
1987	385,868	40,634	275,664	1.7	153,200	25,428	193,959	10.5	20.9	2.59	1.46	3.1	58¼–35	16.0

a Fiscal year ends Sept. 30. b Excludes extraordinary net loss on extinguishment of debt of $4.1 million ($0.07 per share). c From continuing operations: excludes net income from discontinued operations of $245 million ($2.56 per share) but includes special net costs of $206.2 million ($2.15 per share) to curtail and consolidate product lines, reduce the carrying value of certain assets, increase environmental remediation costs, and reduce employees. d From continuing operations: excludes net income from discontinued operations of $11.6 million ($0.13 per share) but includes gain on sale of fragrance and skin care business, before taxes, of $12.0 million ($0.13 per share). e Arco Chemical, previously a subsidiary of Atlantic Richfield Co., became an independent, publicly owned company on Oct. 5, 1987. f Pro forma.

2 Finances of the U.S. Chemical Industry

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
	(Money figures in thousands of dollars unless otherwise indicated)													
Borden Chemicals & Plastics Ltd. Partnership														
1990	$420,631	$45,296	$544,204	1.6	$395,762	$22,084	$314,558	10.8%	14.4%	$1.22[a]	$1.95[a]	19.0%	$12¾–7¾[a]	8.4
1989	465,923	69,495	549,628	1.9	417,188	28,157	341,707	14.9	20.3	1.87[a]	2.45[a]	14.4	24–10[a]	9.1
1988	552,975	121,014	604,822	1.7	429,280	16,877	363,271	21.9	33.3	3.26[a]	3.02[a]	19.5	20⅛–10⅞[a]	4.8
1987[b]	35,894	4,781	560,319	1.7	449,258	3,485	354,534	13.3	—	0.13[a]	0.11[a]	1.0	12–9¾[a]	83.7
Cabot Corp.														
1990[c]	$1,684,658	$71,030	$1,627,435	1.3	$878,651	$174,435	$466,155	4.2%	15.2%	$2.73	$1.04	3.3%	$37½–25	11.4
1989[c]	1,936,912	(6,509)[d,e]	1,400,550	1.4	743,179	192,302	472,333	—	—	(0.40)[d,e]	1.01	2.5	45–34⅞	—
1988[c]	1,676,588	61,175[f]	1,530,186	1.3	838,909	169,957	594,295	3.6	10.3	2.27[f]	0.92	2.5	48⅜–25½	16.3
1987[c]	1,424,041	39,235[g]	1,447,001	1.2	794,470	81,087	574,610	2.8	6.8	1.42[g]	0.92	2.8	45⅛–25½	24.9
Chemed Corp.														
1990	$599,379	$16,554	$272,857	1.5	$65,996	$12,994	$57,843	2.8%	28.6%	$1.60	$1.96	7.1%	$36¼–18⅛	19.7
1989	591,824	26,182	279,181	1.7	65,814	14,116	64,634	4.4	40.5	2.61	1.84	5.2	38⅝–32½	13.6
1988	500,647	20,649[h]	268,496	1.7	61,102	14,641	57,061	4.1	36.2	2.23[h]	1.72	5.1	36–29¾	15.2
1987	391,004	20,362	220,549	1.5	48,545	8,893	69,944	5.2	29.1	2.28	1.60	4.5	44⅛–26⅝	15.5
Crompton & Knowles Corp.														
1990	$390,032	$30,010	$252,177	1.8	$76,709	$16,374	$87,098	7.7%	34.5%	$1.22	$0.39	2.1%	$23⅛–13⅜	15.0
1989	355,817	24,501	190,330	1.6	50,847	13,407	71,381	6.9	34.3	1.00	0.29	2.5	15¾–7½	11.6
1988	289,787	16,845[i]	177,204	1.5	43,685	7,050	53,483	5.8	31.5	0.71[i]	0.21	3.1	9–5	9.8
1987	237,469	11,750	127,689	2.2	29,085	3,632	68,265	4.9	17.2	0.49	0.17	2.8	7⅛–4½	12.4
Dexter Corp.														
1990	$907,946	$42,150	$696,978	2.5	$272,147	$43,910	$278,293	4.6%	15.1%	$1.74	$0.88	4.1%	$24½–18	12.2
1989	848,724	42,977	611,277	2.3	252,895	33,119	242,068	5.1	17.8	1.73	0.82	3.0	34¼–20⅛	15.9
1988	827,266	39,889[j]	540,960	2.2	186,894	26,145	221,795	4.8	18.0	1.61[j]	0.80	3.3	28¾–20¼	15.2
1987	782,781	42,785	517,296	2.3	183,972	23,619	205,269	5.5	20.8	1.72	0.60	2.4	32⅝–17	14.4
Dow Chemical Co.														
1990	$19,773,000	$1,384,000	$19,764,000	1.4	$8,249,000	$2,119,000	$4,539,000	7.0%	30.5%	$5.10	$2.60	4.6%	$75¾–37	11.1
1989	17,600,000	2,487,000	18,169,000	1.1	7,642,000	1,764,000	3,960,000	14.1	62.8	9.20	2.18	3.4	72¼–55½	6.9
1988	16,682,000	2,410,000[k]	15,548,000	1.9	6,576,000	1,267,000	6,564,000	14.4	36.7	8.55[k]	1.63	2.9	62⅝–51⅛	6.7
1987	13,377,000	1,245,000[l]	13,871,000	1.7	5,551,000	995,000	5,284,000	9.3	23.6	4.33[l]	1.40	2.5	73–39⅛	13.0
E. I. du Pont de Nemours & Co.														
1990	$40,047,000	$2,310,000	$37,332,000	1.2	$21,102,000	$5,383,000	$15,622,000	5.8%	14.8%	$3.40	$1.62	4.3%	$42⅜–31⅜	10.8
1989	35,534,000	2,480,000	33,829,000	1.2	18,876,000	4,285,000	14,912,000	7.0	16.6	3.53	1.45	4.1	42⅛–28⅝	10.0
1988	32,917,000	2,190,000	30,159,000	1.5	17,221,000	4,001,000	15,020,000	6.7	14.6	3.04	1.23	4.4	30⅞–25¼	9.3
1987	30,468,000	1,786,000	27,604,000	1.5	15,854,000	3,035,000	13,639,000	5.9	13.1	2.46	1.10	3.2	43⅝–25	13.9
Ethyl Corp.														
1990	$2,513,755[m]	$232,189	$6,588,643	2.1	$677,028	$151,822	$946,539	9.2%	24.5%	$1.95	$0.60	2.2%	$33–20½	13.7
1989	2,431,654[m]	219,468[n]	5,507,009	2.3	579,760	119,082	776,785	9.0	28.3	1.83[n]	0.51	2.0	29–21⅛	13.7
1988	2,717,965[m]	231,016	5,107,817	2.5	719,551	151,116	986,289	8.4	23.4	1.91	0.45	2.2	24⅛–17¼	10.8
1987	2,274,702[m]	193,319	4,214,975	2.2	674,075	136,481	852,799	8.5	22.7	1.57	0.40	1.7	32¼–15	15.0
Ferro Corp.														
1990	$1,124,833	$19,419	$672,282	1.6	$255,930	$59,694	$292,221	1.7%	6.6%	$0.83	$0.64	2.7%	$29⅜–17¼	28.1
1989	1,083,573	49,748	655,206	1.8	220,022	49,581	283,144	4.6	17.6	2.30	0.60	1.9	41⅜–22⅜	13.8
1988	1,008,990	46,620	574,943	1.7	197,222	49,308	282,137	4.6	16.5	2.26	0.46	2.3	27⅛–14	9.1
1987	871,088	31,687	521,314	1.7	171,889	30,674	249,039	3.6	12.7	1.53	0.45	2.7	20⅞–11⅝	10.6
First Mississippi Corp.														
1990[o]	$497,539	$4,374	$497,453	1.8	$310,032	$64,600	$175,344	0.9%	2.5%	$0.22	$0.30	1.9%	$19¼–11⅝	70.2
1989[o]	433,469	16,511	472,394	1.7	280,008	107,011	187,145	3.8	8.8	0.81	0.285	1.6	20½–14½	21.6
1988[o]	318,086	32,475	325,339	1.5	166,966	60,381	181,447	10.2	17.9	1.61	0.24	1.7	19⅛–9½	8.9
1987[o]	278,946	18,610	276,638	1.8	152,671	19,527	138,882	6.7	13.4	0.93	0.24	2.6	13⅜–5⅜	10.1
Georgia Gulf Corp.														
1990	$932,104	$95,344	$439,229	1.3	$214,749	$58,111	$(441,904)[p]	10.2%	—	$3.07	—	—	$45⅝–47⅞	7.2
1989	1,104,468	191,990	455,561	2.3	209,080	54,159	305,828	17.4	62.8%	7.58	$1.00	2.1%	59⅞–36	6.3
1988	1,060,612	193,604	437,083	2.0	189,256	25,062	235,839	18.3	82.1	6.75	0.65	2.0	39⅞–24⅜	4.8
1987	707,435	91,736[q]	308,609	1.7	119,984	9,931	142,546	13.0	64.4	3.15[q]	0.20	0.9	34½–9⅞	7.1

a Per partnership preference unit. b Borden Chemicals & Plastics, previously the basic chemicals and polyvinyl chloride operations of Borden Inc., commenced independent operations as a publicly owned limited partnership Nov. 30, 1987. c Fiscal year ends Sept. 30. d Net loss. e From continuing operations: includes pretax loss on restructuring of energy group of $71.7 million but excludes net gain from sale of discontinued operations of $24.6 million ($0.95 per share). f Excludes extraordinary net charge on early retirement of debt of $816,000 ($0.03 per share). g Excludes extraordinary net charge on early retirement of debt of $10.5 million ($0.38 per share). h From continuing operations: excludes net income from discontinued operations, extraordinary net gain on termination of pension plan, and cumulative effect of changes in accounting principles of $3.5 million ($0.37 per share). i From continuing operations: excludes net loss from operations and disposal of maintenance chemicals business of $1.5 million ($0.12 per share). j From continuing oeprations: excludes net loss from discontinued operations of $4.4 million ($0.18 per share). k Excludes net loss on early extinguishment of debt of $12 million ($0.04 per share). l Excludes net loss on early extinguishment of debt of $5 million ($0.02 per share). m Includes insurance revenues. n From continuing operations: excludes income from spun-off aluminum, plastics, and energy businesses of $11.9 million ($0.10 per share). o Fiscal year ends June 30. p Deficit. q Excludes net charge on retirement of debt of $9.9 million ($0.34 per share).

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
						(Money figures in thousands of dollars unless otherwise indicated)								
B. F. Goodrich Co.														
1990	$2,419,700	$115,800[a]	$2,198,400	1.4	$1,109,300	$243,000	$1,200,300	4.8%	9.6%	$4.20[a]	$2.12	5.5%	$47⅞–29½	9.2
1989	2,419,700	171,200[b]	2,102,900	2.0	991,500	240,400	1,117,000	7.1	15.3	6.23[b]	2.00	3.7	69–38½	8.6
1988	2,416,700	209,900[c]	1,987,300	1.9	934,400	180,500	1,080,200	8.7	19.4	7.99[c]	1.72	3.5	60¾–37½	6.1
1987	2,168,000	83,900[d]	1,905,800	1.4	898,200	142,600	972,600	3.9	8.6	3.17[d]	1.56	3.4	65–27¼	14.6
W. R. Grace & Co.														
1990	$6,754,000	$202,800	$5,875,900	1.4	$2,462,100	$513,700	$1,561,900	3.0%	13.0%	$2.36	$1.40	5.5%	$33⅜–17	10.7
1989	6,114,600	256,600[e]	5,321,300	1.3	2,220,000	484,600	1,432,600	4.2	17.9	3.01[e]	1.40	4.4	39⅛–25⅛	10.7
1988	5,786,100	192,000[f]	5,095,200	1.3	2,028,300	418,100	1,336,000	3.3	14.4	2.26[f]	1.40	5.2	29⅞–23½	11.8
1987	4,515,400	141,900[g]	4,361,500	1.4	1,701,000	242,500	1,351,200	3.1	10.5	1.67[g]	1.40	5.0	37⅛–19⅛	16.9
Great Lakes Chemical Corp.														
1990	$1,066,298	$140,849	$1,200,595	2.0	$363,798	$48,565	$538,457	13.2%	26.2%	$4.01	$0.46	0.9%	$65⅞–40¾	13.3
1989	792,327	122,918	934,802	2.0	275,864	40,466	428,263	15.5	28.7	3.52	0.38	1.0	48–28⅛	10.8
1988	557,770	103,288	612,242	1.7	234,405	47,017	430,629	18.5	24.0	2.97	0.34	1.2	33–24¼	9.7
1987	478,386	55,536	523,365	1.8	218,403	35,186	338,880	11.6	16.4	1.67	0.30	1.1	38½–18	16.9
Hercules														
1990	$3,199,932	$95,993	$3,699,644	1.8	$1,449,912	$272,591	$1,941,989	3.0%	4.9%	$2.04	$2.24	6.7%	$41½–25⅛	16.5
1989	3,091,669	(96,359)[h,i]	3,653,163	1.7	1,416,475	292,554	1,897,206	—	—	(2.09)[h,i]	2.24	4.9	52¼–38⅜	—
1988	2,802,072	120,435	3,325,294	2.6	1,164,102	251,043	2,044,533	4.3	5.9	2.55	2.00	4.1	54–42⅝	18.9
1987	2,693,003	208,000[j]	3,492,077	3.6	1,075,389	205,037	2,189,867	7.7	9.5	4.02[j]	1.84	3.2	73½–40	14.1
Imcera														
1990[k]	$1,424,600	$58,900[l]	$1,750,800	1.6	$585,800	$85,700	$444,700	4.1%	13.2%	$2.53[l]	$1.00	1.9%	$62⅛–42⅜	20.7
1989[k]	982,900	110,300[m]	1,753,000	3.2	480,200	82,200	669,600	11.2	16.5	4.20[m]	1.00	2.4	47⅜–37¼	10.1
1988[k]	1,470,600	103,900[n]	1,588,900	2.0	445,800	69,100	822,800	7.1	12.6	3.30[n]	1.00	2.5	53–28	12.7
1987[k]	1,637,500	14,600[o]	2,242,400	1.4	2,292,500	62,500	877,200	0.9	1.7	0.06[o]	1.00	2.9	44½–25	434.4
IMC Fertilizer Group														
1990[k]	$1,105,700	$82,600	$1,584,700	1.2	$1,144,100	$94,300	$819,700	7.5%	10.1%	$3.13	$1.08	3.0%	$39¾–31⅛	11.3
1989[k]	1,221,700	137,300	1,677,900	1.4	1,144,100	55,300	765,300	11.2	17.9	5.27	1.02	2.5	49¾–32½	7.8
1988[k,p]	1,085,600	111,700	1,472,100	1.6	780,000	26,300	676,100	10.3	16.5	3.88	0.37	1.1	45⅛–22½	8.7
1987[k]	876,200	26,600	1,332,200	1.7	841,600	110,400	1,004,300	3.0	2.6	0.10	—	—	—	—
International Flavors & Fragrances														
1990	$962,810	$156,681	$1,129,395	5.4	$266,860	$42,931	$898,193	16.3%	17.4%	$4.11	$2.16	3.3%	$75⅛–54⅝	15.8
1989	869,519	138,565	969,649	5.1	236,505	34,178	764,913	15.9	18.1	3.65	1.92	3.0	77½–48½	17.3
1988	839,545	128,684	882,333	5.0	228,152	40,812	695,433	15.3	18.5	3.40	1.60	3.3	54½–43⅛	14.4
1987	745,861	107,017	874,554	4.2	219,305	36,946	659,908	14.3	16.2	2.83	1.24	2.6	57¾–37¼	16.8
Lawter International														
1990	$150,005	$23,420	$153,500	4.2	$28,612	$6,198	$105,090	15.6%	22.3%	$0.73	$0.39	3.9%	$11⅛–8⅝	13.7
1989	136,006	19,468	133,968	3.9	24,412	3,073	87,752	14.3	22.2	0.61	0.39	4.1	10–8½	15.6
1988	125,818	20,851	125,210	3.7	24,546	4,524	79,521	16.6	26.2	0.88	0.52	4.2	14⅛–10¾	14.1
1987	112,018	16,701	109,917	4.3	22,603	1,528	69,458	14.9	24.0	0.71	0.42	3.5	15⅝–8½	17.0
Loctite Corp.														
1990[k]	$509,737	$61,372	$411,687	2.8	$91,256	$26,917	$258,635	12.0%	23.7%	$3.39	$1.14	2.2%	$61–40⅞	15.0
1989[k]	456,498	54,476	344,206	2.8	70,143	15,983	211,805	11.9	25.7	3.03	0.90	2.5	45¼–28⅛	12.0
1988[k]	416,880	41,850	328,833	2.4	73,008	14,466	187,100	10.0	22.4	2.32	0.61	2.1	39–19	12.5
1987[k]	337,802	30,655	289,367	1.9	70,802	15,470	167,561	9.1	18.3	1.69	0.47	1.8	31⅝–19½	15.1
Lubrizol Corp.														
1990	$1,444,758	$127,146[q]	$1,097,091	2.5	$353,551	$77,407	$718,706	8.8%	17.7%	$3.55[q]	$1.46	3.6%	$49–33	11.5
1989	1,220,386	93,980	960,184	2.9	316,493	64,721	663,264	7.7	14.2	2.52	1.38	3.5	45⅛–34⅛	15.7
1988	1,117,493	131,206[r]	970,671	3.0	298,670	54,611	664,308	11.7	19.8	3.40[r]	1.30	3.6	42⅜–30	10.6
1987	1,013,430	81,335	939,378	3.0	297,573	42,040	621,633	8.0	13.1	2.06	1.22	3.6	41¾–25¼	16.3

a From continuing operations: excludes income from discontinued operations of $20.5 million ($0.25 per share). b From continuing operations: excludes net income from discontinued operations of $1.2 million ($0.04 per share). c From continuing operations: excludes net loss from discontinued operations of $12.1 million ($0.45 per share) and net gain from cumulative effect of change in accounting for income taxes of $2.7 million ($0.11 per share). d From continuing operations: excludes net loss from discontinued operations of $4.7 million ($0.20 per share) and extraordinary net income of $25.8 million ($1.09 per share). e From continuing operations: excludes net loss from discontinued operations of $3.4 million ($0.04 per share). f From continuing operations: excludes net income from discontinued operations and net gain from cumulative effect of accounting change of $41.6 million ($0.49 per share). g From continuing operations: excludes net income from discontinued operations of $18.6 million ($0.22 per share) and tax benefit of operating loss carry-forward of $12.6 million ($0.14 per share). h Net loss. i Excludes net gain from cumulative effect of accounting changes of $15.0 million ($0.33 per share). j Excludes net gain on disposal of Himont and other net gains and charges of $613.7 million ($10.72 per share). k Fiscal year ends June 30. l From continuing operations: excludes gain on sale of fragrance business, after taxes, of $5.2 million ($0.25 per share) and charges for environmental and litigation costs related to previously sold operations of $7.6 million ($0.36 per share). m From continuing operations: excludes net gain from discontinued operations of $6.7 million ($0.29 per share). n From continuing operations: excludes net loss on disposal of discontinued operations of $5.0 million ($0.19 per share) and extraordinary credit of $16.2 million ($0.55 per share). o From continuing operations: excludes net income on disposal of discontinued operations of $11.3 million ($0.41 per share) and extraordinary net charge of $4.8 million ($0.18 per share). p IMC Fertilizer Group, previously the fertilizer business group of International Minerals & Chemical Corp., became an independent, privately owned company on Feb. 2, 1988. q From continuing operations: excludes gain, after taxes, on sale of Genentech stock of $62.9 million ($1.79 per share) but includes charge for write-off of $9.7 million in inventories and receivables due from a former affiliate. r Includes credit for patent litigation settlement, before taxes, of $81.2 million but excludes net credit for cumulative effect of change in accounting for income taxes of $8.8 million ($0.22 per share).

2 Finances of the U.S. Chemical Industry

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in thousands of dollars unless otherwise indicated)									
Monsanto Co.														
1990	$8,995,000	$546,000[a]	$7,811,000	1.6	$3,492,000	$750,000	$2,664,000	6.1%	20.5%	$4.23[a]	$1.88	3.8%	$60⅛–38¾	11.7
1989	8,681,000	679,000[b]	6,922,000	1.7	3,173,000	607,000	2,259,000	7.8	30.1	5.02[b]	1.65	3.2	62⅛–40¼	10.2
1988	8,293,000	591,000	6,671,100	1.3	3,146,000	590,000	2,010,000	7.1	29.4	4.14	1.475	3.6	46⅛–36¾	10.0
1987	7,639,000	436,000[c]	6,502,000	1.4	3,076,000	505,000	1,948,000	5.7	22.4	2.82[c]	1.375	3.5	50⅛–28½	14.0
Morton International														
1990[d]	$1,638,700	$134,800	$1,448,000	1.8	$646,200	$113,300	$842,400	8.2%	21.0%	$2.80	$0.86	2.3%	$44¾–31½	13.6
1989[d]	1,406,600	97,100	1,169,600	1.8	553,400	131,900	706,000	6.9	13.8	2.03	—	—	41⅞–37½	18.1
1988[d]	1,248,300	116,400[e]	994,800	2.0	478,600	97,700	606,000	9.3	19.2	2.43[e]	0.82[f]	2.0[f]	46–35⅝[f]	—
1987[d]	1,093,900	105,000	1,426,400[f]	1.5[f]	655,900[f]	72,500	700,400[f]	9.6	—	2.21	0.745[f]	1.7[f]	54¾–31[f]	—
NL Industries														
1990	$906,589	$93,506[g]	$1,966,695	2.2	$577,114	$195,304	$38,568	10.3%	242.4%	$1.42[g]	$0.60	3.5%	$24¾–9¼	12.0
1989	1,000,883	170,274[h]	1,512,315	0.9	380,465	83,386	137,310	17.0	124.0	2.57[h]	0.60	2.6	28–18¾	9.1
1988[i]	1,007,036	134,236[i]	836,941	1.4	344,020	70,624	150,951	13.3	88.9	2.02[i]	0.20[k]	3.1	7¾–5¼	—
1987[i]	859,267	87,866[i]	1,092,483	1.5	315,907	73,318	406,220	10.2	21.6	1.31[i]	0.20[k]	2.6	11–4¼	—
Nalco Chemical Co.														
1990	$1,212,258	$131,077	$991,833	2.3	$419,269	$114,919	$410,395	10.8%	31.9%	$1.71	$0.76	2.9%	$30⅝–22	15.4
1989	1,070,754	119,909	892,006	2.3	350,886	86,435	397,207	11.2	30.2	3.01	1.36	3.2	49⅞–34½	14.3
1988	994,150	105,971	794,899	2.0	311,200	61,578	433,550	10.7	24.4	2.70	1.29	3.6	39⅞–31¼	13.2
1987	841,876	80,254	696,360	1.7	304,084	57,232	396,297	9.5	20.3	2.03	1.20	3.5	45½–24	17.1
Olin Corp.														
1990	$2,592,000	$84,000	$1,760,000	1.4	$829,000	$187,000	$609,000	3.2%	13.8%	$4.03	$1.70	3.4%	$60–40	12.4
1989	2,509,000	124,000	1,794,000	1.3	781,000	142,000	555,000	4.9	22.3	6.02	1.95	3.3	68¼–49⅝	10.2
1988	2,308,000	98,000	1,799,000	1.3	801,000	147,000	542,000	4.2	18.1	4.63	1.70	3.4	60–40	10.8
1987	1,930,000	78,000	1,583,000	1.7	727,000	115,000	598,000	4.0	13.0	3.38	1.60	3.6	56¼–32⅝	13.1
Quantum Chemical Corp.														
1990	$2,656,100	$21,200	$3,139,500	2.0	$2,020,200	$458,400	$(183,500)[m]	0.8%	—	$0.79	—	—	$31⅜–8⅛	12.7
1989	2,671,000	114,100[n]	2,910,300	1.7	1,759,300	583,300	(265,800)[m]	4.3	—	4.45[n]	$2.16[o]	3.3%	107⅛–28½	14.9
1988	2,921,900	360,100[p]	2,881,300	0.7	1,308,600	333,500	(433,400)[m]	12.3	—	13.71[p]	2.40[q]	2.8	108¼–65½	6.3
1987	2,566,800	143,600[r]	2,519,300	1.3	1,380,200	154,200	983,500	5.6	14.6%	4.38[r]	2.20	3.4	88–42½	14.9
Rohm & Haas Co.														
1990	$2,824,000	$207,000[s]	$2,645,000	1.7	$1,390,000	$412,000	$1,176,000	7.3%	17.6%	$3.10[s]	$1.22	4.0%	$37–24¼	9.9
1989	2,661,000	176,000[t]	2,361,000	1.7	1,148,000	385,000	1,217,000	6.6	14.5	2.65[t]	1.16	3.4	37½–31	12.9
1988	2,535,000	230,000	2,148,000	1.7	935,000	338,000	1,113,000	9.1	20.7	3.46	1.02	3.1	37½–28	9.5
1987	2,203,000	195,000[u]	1,882,000	1.9	730,000	222,000	981,000	8.9	19.9	2.85[u]	0.86	2.2	53¼–24	13.6
Sigma-Aldrich Corp.														
1990	$529,103	$71,248	$546,190	3.4	$192,372	$32,535	$368,468	13.5%	19.3%	$1.44	$0.205	0.7%	$35⅝–25⅝	21.1
1989	441,099	63,958	472,424	2.6	176,431	51,703	298,851	14.5	21.4	2.59	0.37	0.7	59½–43¾	19.9
1988	375,282	56,477	359,671	2.5	119,518	35,605	243,906	15.0	23.2	2.29	0.33	0.7	51¼–39¾	19.9
1987	304,858	41,889	285,343	2.9	96,975	20,616	196,012	13.7	21.4	1.70	0.29	0.7	50⅝–30¼	23.8
Stepan Co.														
1990	$389,612	$14,491	$246,992	1.6	$143,342	$38,375	$82,698	3.7%	17.5%	$2.64	$0.58	2.6%	$27¼–16⅝	8.3
1989	346,350	7,840	215,351	1.7	122,509	34,090	70,741	2.3	11.1	1.42	0.53	2.2	29½–17¾	16.6
1988	333,033	13,428	185,601	1.6	104,697	20,442	66,790	4.0	20.1	2.39	0.475	2.1	25⅝–19¾	9.5
1987	288,935	10,959	172,726	1.6	98,994	25,705	59,936	3.8	18.3	1.83	0.415	2.0	26¾–14½	11.2
Sterling Chemicals														
1990[v]	$506,046	$59,083	$352,024	1.4	$216,015	$19,915	$108,240	11.7%	54.6%	$1.07	$1.00	14.4%	$8⅝–5¼	6.5
1989[v]	580,797	103,898	329,040	1.5	216,355	57,592	110,372	17.9	94.1	1.77	0.75	5.9	16¾–6⅞	7.2
1988[v]	698,964	213,845[w]	294,242	1.4	172,881	16,993	90,562	30.6	236.1	3.56[w]	3.17	—	17¾–14⅛	4.5
1987[v]	413,192	51,385[x]	283,375	1.2	169,119	13,174	60,184	12.4	85.4	0.86[x]	—	—	—	—
Union Carbide Corp.														
1990	$7,621,000	$308,000[y]	$8,587,000	1.0	$4,325,000	$744,000	$2,227,000	4.0%	13.8%	$2.19	$1.00	5.1%	$24⅞–14⅛	8.9
1989	8,744,000	573,000	8,483,000	1.1	4,584,000	785,000	2,320,000	6.6	24.7	4.07	1.00	3.6	33¼–22¾	6.9
1988	8,324,000	662,000	8,389,000	1.1	4,416,000	671,000	1,784,000	8.0	37.1	4.88	1.15	5.1	28⅝–17	4.6
1987	6,914,000	232,000	7,820,000	1.3	4,344,000	502,000	1,175,000	3.4	19.7	1.76	1.50	6.2	32½–15½	13.6

a Includes net gain on divestitures of $56 million ($0.43 per share). b Includes net gain on sale of analgesics business of $36 million ($0.27 per share). c Includes net restructuring income of $18 million ($0.12 per share). d Fiscal year ends June 30. e Excludes net charge for cumulative effect of change in accounting for income taxes of $3.8 million ($0.07 per share). f Data for Morton Thiokol, of which Morton International was a part until July 1, 1989. g Excludes extraordinary net loss of $1.1 million ($0.02 per share). h Excludes extraordinary net gain of $2.6 million ($0.04 per share). i Restated to reflect restructuring and spin-off of petroleum services business on Dec. 22, 1988 (except as noted). j From continuing operations: excludes net income from discontinued operations of $21.5 million ($0.32 per share). k Before restructuring. l From continuing operations: excludes net loss from discontinued operations of $107.8 million ($1.64 per share). m Deficit. n From continuing operations: excludes net income and net gain on sale of oleochemical business of $133.3 million ($5.31 per share). o Plus 1% stock dividend. p From continuing operations: excludes net income from discontinued oleochemical business of $22.6 million ($0.86 per share). q Excludes special dividend declared of $50 per share. r From continuing operations: excludes net income from discontinued spirits and wine operations of $108.0 million ($3.37 per share). s Includes net gain on sale of surfactant and alkylphenol businesses of $26 million ($0.39 per share), on sale of forest property of $20 million ($0.20 per share), and net loss for write-off of intangible assets in its electronic materials business of $18 million ($0.27 per share). t Includes net gain on sale of interest in U.K. subsidiary of $15 million ($0.23 per share) and net loss on write-off of assets of $13 million ($0.20 per share). u Includes net gain on sale of assets of $5.0 million ($0.07 per share). v Fiscal year ends Sept. 30. w Excludes net loss on early extinguishment of debt of $9.0 million ($0.15 per share) and net gain on cumulative effect of change in accounting for income taxes of $8.3 million ($0.14 per share). x Excludes net loss on early extinguishment of debt of $4.0 million ($0.07 per share). y Includes net loss of $104 million from sale of assets in carbon products business.

Year	Net sales	Net income	Total assets	Current ratio	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
							(Money figures in thousands of dollars unless otherwise indicated)							
Vista Chemical Corp.														
1990[a]	$718,831	$58,607[b]	$658,023	1.0	$434,892	$137,434	$(121,720)[c]	8.1%	—	$5.97[b]	$1.80	5.5 %	$43⅞–21¾	5.5
1989[a]	778,902	119,902[d]	550,594	1.4	341,109	99,011	(172,619)[c]	15.4	—	8.56[d]	1.80	3.4	62–42½	6.1
1988[a]	781,351	123,917[e]	500,643	1.6	275,544	48,082	119,438	15.9	103.8%	7.10[e]	0.35	0.9	60⅛–21⅝	5.7
1987[a]	608,887	(1,762)[f,g]	474,265	1.5	266,250	20,889	134,686	—	—	(0.13)[f,g]	0.05	0.1	54¼–17	—
Witco Corp.														
1990	$1,631,481	$67,954	$1,135,685	2.8	$471,026	$90,845	$544,272	4.2%	12.5%	$2.95	$1.72	5.6 %	$39⅞–21¾	10.4
1989	1,587,788	35,009	1,121,358	3.5	417,175	70,387	553,684	2.2	6.3	1.60	1.61	4.0	45⅛–34⅝	24.9
1988	1,585,856	71,621[h]	1,096,219	3.1	400,996	72,059	559,985	4.5	12.8	3.05[h]	1.39	4.0	38⅜–30⅝	11.3
1987	1,427,650	63,293	1,037,624	3.0	374,628	69,082	494,941	4.4	12.8	2.72	1.16	3.1	47⅜–26⅝	13.6
PHARMACEUTICALS														
Abbott Laboratories														
1990	$6,158,682	$965,774	$5,563,151	1.2	$2,375,782	$641,391	$2,833,617	15.7%	34.1%	$2.22	$0.84	2.2 %	46⅜–31¼	17.5
1989	5,379,751	859,832	4,851,635	1.5	2,090,166	573,138	2,726,413	16.0	31.5	1.93	0.70	2.4	35⅛–23⅛	15.1
1988	4,936,991	752,027	4,825,113	1.6	1,952,622	521,196	2,464,649	15.2	30.5	1.67	0.60	2.5	26⅛–21⅜	14.3
1987	4,387,876	632,559	4,385,737	1.3	1,741,557	432,736	2,093,453	14.4	30.2	1.39	0.50	1.9	33½–20	19.3
American Home Products Corp.														
1990	$6,775,182	$1,230,597	$5,353,893	3.5	$1,437,390	$247,593	$2,392,008	18.2%	51.4%	$3.92	$2.15	4.3 %	$55–44	12.6
1989	6,747,016	1,102,158	5,114,491	3.0	1,481,686	250,737	1,403,027	16.3	78.6	3.54	1.95	4.1	54½–40⅛	13.4
1988	5,500,533	932,184	3,967,479	2.8	1,309,314	344,464	2,332,475	16.9	40.0	3.19	1.80	4.6	42⅛–35½	12.2
1987	5,028,272	845,081	3,956,855	2.0	1,153,028	216,525	1,878,178	16.8	45.0	2.86	1.67	4.2	48⅜–31	13.9
Bristol-Myers Squibb Co.														
1990	$10,300,000	$1,748,000	$9,023,000	2.0	$2,631,000	$526,000	$5,226,000	17.0%	33.4%	$3.33	$2.12	3.6 %	$68–50½	17.8
1989	9,189,000	747,000[i]	8,273,000	2.1	2,350,000	562,000	4,860,000	8.1	15.4	1.43[i]	2.00	3.9	58–44	35.7
1988	8,558,000	1,254,000	8,045,000	2.1	2,188,000	471,000	4,720,000	14.7	26.6	2.39	1.68[j]	4.0[j]	46½–36⅛[j]	14.7[j]
1987	7,558,000	1,068,000[k]	7,305,000	2.4	1,927,000	190,000[j]	4,546,000	14.1	23.5	1.98[k]	1.40[j]	3.3[j]	55¾–28¼[j]	17.0[j]
Eli Lilly & Co.														
1990	$5,191,600	$1,127,300	$6,673,700	0.9	$2,936,700	$1,007,300	$2,998,400	21.7%	37.6%	$3.90	$1.64	2.2 %	$89¾–59⅜	19.1
1989	4,175,600	939,500	5,394,400	1.7	2,114,600	554,500	3,303,500	22.5	28.4	3.20	1.35	2.4	68½–42⅝	17.3
1988	3,607,400	761,000	4,852,800	1.7	1,806,600	372,100	2,815,400	21.1	27.0	2.67	1.15	2.8	45¾–35½	15.3
1987	3,236,100	410,500[l]	4,859,200	1.8	1,642,500	344,100	2,646,900	12.7	15.5	1.41[l]	1.00	2.4	53⅜–28⅛	29.2
Merck & Co.														
1990	$7,671,500	$1,781,200	$7,872,700	1.3	$2,721,700	$670,800	$3,677,300	23.3%	48.4%	$4.56	$1.91	2.4 %	$91⅛–67	17.3
1989	6,550,500	1,495,400	6,593,400	1.8	2,292,500	433,000	3,357,300	22.8	44.5	3.78	1.64	2.4	80¾–56¼	18.1
1988	5,939,500	1,206,800	5,992,100	1.7	2,070,700	372,700	2,720,400	20.3	44.4	3.05	1.28	2.4	59⅝–48	17.6
1987	5,061,300	906,400	5,533,200	1.3	1,948,000	253,700	1,969,900	17.9	46.0	2.23	0.82	1.4	74¼–40⅝	25.8
Pfizer														
1990	$6,406,000	$801,200	$8,553,300	1.4	$2,109,800	$547,500	$4,593,300	12.5%	17.4%	$2.38	$1.20	3.5 %	$40⅞–27¼	14.3
1989	5,671,500	681,100	7,894,800	1.5	1,784,100	456,500	4,105,800	12.0	16.6	2.02	1.10	3.4	37⅞–27	16.1
1988	5,385,400	791,300	7,218,200	1.7	1,655,100	343,700	3,881,700	14.7	20.4	4.70	2.00	3.7	60¼–47⅜	11.4
1987	4,919,800	690,200	6,684,700	2.0	1,505,900	258,300	3,644,500	14.0	18.9	4.08	1.80	3.1	77–40	14.3
Schering-Plough Corp.														
1990	$3,322,900	$565,100	$3,936,900	1.3	$1,264,400	$242,900	$1,914,800	17.0%	29.5%	$2.50	$1.065	2.4 %	$50¾–37	17.6
1989	3,157,900	471,300	3,440,000	1.7	1,210,700	186,100	1,781,900	14.9	26.4	2.09	0.875	2.5	43–27⅝	16.9
1988	2,969,400	389,900	3,234,500	1.2	1,181,000	156,100	1,485,900	13.1	26.2	1.74	0.70	2.7	29⅝–22⅝	15.0
1987	2,699,300	320,700[m]	3,053,200	1.2	1,131,000	118,000	1,317,300	11.9	24.3	1.38[m]	0.51	2.4	27⅝–15⅝	15.6
Upjohn Co.														
1990	$3,020,868	$458,067[n]	$3,667,675	1.7	$1,421,570	$246,763	$1,779,625	15.2%	25.7%	$2.48[n]	$1.04	2.7 %	$44⅝–33	15.7
1989	2,724,809	323,633[o]	3,231,503	1.6	1,275,134	242,260	1,736,125	11.9	18.6	1.74[o]	0.94	2.7	42⅛–27⅝	21.8
1988	2,746,248	368,739[p]	3,139,328	1.6	1,239,598	240,997	1,820,952	12.9	19.4	1.97[p]	0.80	2.6	35¼–26⅞	15.8
1987	2,521,024	305,039	3,043,131	1.9	1,114,391	211,976	1,673,512	12.1	18.2	1.63	0.63	1.6	53¾–23¼	23.6
Warner-Lambert Co.														
1990	$4,686,900	$484,900	$3,099,700	1.2	$1,301,400	$239,900	$1,240,700	10.3%	39.1%	$3.61	$1.52	2.5 %	$70⅜–49⅝	16.6
1989	4,195,800	412,700	2,719,700	1.1	1,132,500	218,500	989,700	9.8	41.7	3.05	1.28	2.6	59⅜–37¼	15.8
1988	3,908,400	340,300	2,554,100	1.1	1,053,000	189,600	849,900	8.7	40.0	2.50	1.08	3.1	39¾–30	13.9
1987	3,484,700	295,800	2,396,500	1.1	959,800	176,900	795,000	8.5	37.2	2.08	0.885	2.6	43¾–24⅛	16.4

a Fiscal year ends Sept. 30. b Excludes cumulative effect of change in accounting for income taxes of $4.7 million ($0.44 per share). c Deficit. d Includes net gain associated with change in stock option plan of $568,000. e Includes net gain associated with change in stock option plan of $1.5 million but excludes net loss on extinguishment of debt of $10.8 million ($0.62 per share). f Net loss. g Includes net charge associated with change in stock option plan of $55.4 million and net gain on sale of interest in Petroquímica Argentina of $5.1 million but excludes net loss on extinguishment of debt of $1.9 million ($0.12 per share). h Excludes net gain on cumulative effect of accounting change of $20.3 million ($0.81 per share). i Includes charges and expenses for integrating operations of Bristol-Myers Co. and Squibb Corp., after taxes, of $693 million ($1.32 per share). j For Bristol-Myers Co. only. k Includes gain on sale of orthodontic and animal health businesses, before taxes, of $80.3 million. l From continuing operations: includes restructuring charges, before taxes, of $271.9 million ($1.58 per share) but excludes net income and net gain on sale of discontinued cosmetics business of $233.2 million ($0.79 per share). m Excludes nonrecurring net charge of $4.3 million ($0.02 per share). n From continuing operations: excludes loss on discontinued operations and their disposal of $2.4 million but includes partial pension settlement net gain of $37. 8 million. o From continuing operations: includes restructuring and other nonrecurring charges of $57.3 million but excludes net loss on discontinued operations and their disposal of $147.6 million ($0.79 per share). p From continuing operations: excludes loss from discontinued operations of $15.3 million ($0.08 per share).

Chemical employment changed little in 1990

After three years of steady growth, employment in the chemical industry leveled off last year. Overall employment in the chemicals and allied products industry rose much less than 1% in 1990, to reach nearly 1.09 million. Earlier figures, which had placed chemical employment at more than 1.1 million in early 1990, have been revised downward by the Department of Labor.

The leveling off of the number of people working in the industry was fairly uniform throughout various sectors of the chemical industry. Drug companies registered a 3% gain in employees in 1990, but many sectors—including plastics, paints, agricultural chemicals, and soap and toilet goods producers—had no change in 1990 in the size of their work force.

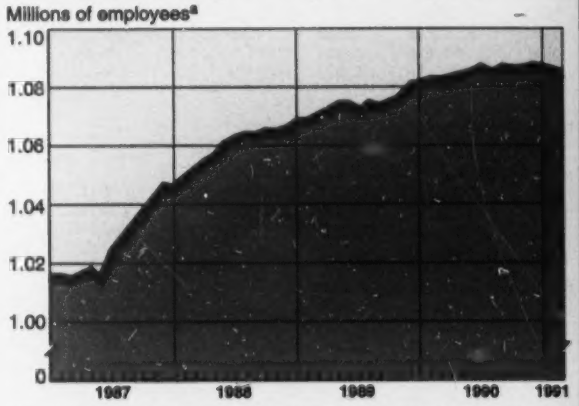
Thus, the 1990 chemical employment levels would seem to be the peak for this employment cycle, which began in late 1986. The previous peak in chemical employment occurred at the end of 1979 and in early 1980, when employment reached more than 1.11 million before dropping 9% to its most recent low of 1.02 million in 1986 and early 1987.

C&EN's company-by-company compilation of employment in the chemical industry showed a 2% overall decline in 1990 in employment at the 21 companies included in the survey. These companies together account for about one third of chemical industry employment.

The number of scientists and engineers employed in the chemical industry continued to grow modestly into 1990, posting a 1% gain over 1989 levels. These numbers reflect how many scientists and engineers are working in industry R&D in January of each year, and so trail the Labor Department's data, which are employment averages for the entire year.

Chemical industry employment is holding up a bit better than that of all manufacturing industries, which posted a 2% decline in 1990. Another indication that the chemical industry is slightly better off than manufacturing as a whole is seen in the length of the workweek. For chemical workers, it rose slightly to 42.6 hours last year, while that of all manufacturing workers eased off.

Chemical industry work force leveled off in 1990 following three years of growth



a Seasonally adjusted employment in U.S. chemicals and allied products industry; February and March 1991 figures are preliminary. Source: Department of Labor

INDUSTRIAL EMPLOYMENT: Little change in 1990 for many chemical industry sectors

Thousands[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
All manufacturing	19,062	19,426	19,350	19,024	18,965	19,260	19,378	18,434	18,781	20,170	20,285	–2%	–1%
Chemicals and allied products	1,086	1,074	1,059	1,026	1,022	1,044	1,049	1,043	1,075	1,109	1,107	0	0
Industrial inorganic chemicals	135	133	133	131	135	143	143	151	161	162	161	2	–2
Plastics materials and synthetics	185	184	177	168	168	172	178	177	185	196	205	0	–1
Drugs	239	233	228	215	208	206	206	201	199	199	196	3	2
Soap, cleaners, and toilet goods	159	160	160	153	147	148	146	142	144	146	141	0	1
Paints and allied products	63	63	63	63	63	64	62	60	60	63	65	0	0
Industrial organic chemicals	153	150	146	148	154	160	162	163	171	178	174	2	–1
Agricultural chemicals	53	53	52	51	54	59	61	61	65	70	72	0	–2
Miscellaneous chemical products	100	100	101	97	94	94	92	89	91	94	93	0	1
Petroleum and coal products	160	157	160	164	169	179	189	196	201	214	198	2	–2
Rubber and miscellaneous plastics products	867	884	868	843	823	819	814	743	729	772	764	–2	1

a Domestic employment. Source: Department of Labor

PRODUCTION WORKERS: Chemical work force declined less than other manufacturing fields

Thousands[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Annual change 1989–90	Annual change 1980–90
All manufacturing	12,936	13,375	13,254	12,970	12,877	13,092	13,285	12,530	12,742	14,020	14,214	−3%	−1%
Chemicals and allied products	599	603	597	575	568	578	583	579	599	628	626	−1	0
Industrial inorganic chemicals	68	69	69	67	69	72	73	77	86	88	87	−1	−2
Plastics materials and synthetics	119	120	116	111	113	114	117	115	119	130	137	−1	−1
Drugs	106	102	101	99	96	95	96	98	98	99	97	4	1
Soap, cleaners, and toilet goods	98	101	103	98	93	94	93	89	90	92	96	−3	0
Paints and allied products	32	32	31	31	30	31	30	29	29	31	33	0	0
Industrial organic chemicals	85	87	86	83	81	82	82	84	86	90	88	−2	0
Agricultural chemicals	33	33	33	32	33	37	38	37	40	44	45	0	−2
Miscellaneous chemical products	59	59	58	55	53	54	54	51	51	54	53	0	1
Petroleum and coal products	105	103	104	107	106	109	111	118	120	134	125	2	−2
Rubber and miscellaneous plastics products	671	688	675	654	639	632	633	574	558	597	588	−2	1

a Domestic employment. **Source:** Department of Labor

EMPLOYMENT OF WOMEN: Drugs, soaps, and toiletries have highest fractions

	1989		1979	
	(thousands)	% of total	(thousands)	% of total
All manufacturing	6410.0	33%	6466.0	31%
Chemicals and allied products	318.1	30	270.7	24
Industrial inorganic chemicals	26.9	20	23.3	14
Plastics materials and synthetics	40.3	22	44.6	21
Drugs	103.4	44	79.1	41
Soap, cleaners, and toilet goods	71.3	45	55.9	40
Paints and allied products	12.5	20	12.7	18
Industrial organic chemicals	29.8	20	25.2	15
Agricultural chemicals	8.5	16	10.0	14
Miscellaneous chemical products	25.5	26	19.9	21
Petroleum and coal products	25.2	16	26.3	13
Rubber and miscellaneous plastics products	331.3	37	281.5	36

a Domestic employment. **Source:** Department of Labor

WORKWEEK: Moved upward for chemicals while all manufacturing declined

Hours[a]	1990	1989	1988
All manufacturing	40.8	41.0	41.1
Chemicals and allied products	42.6	42.4	42.2
Industrial inorganic chemicals	42.9	42.7	42.7
Plastics materials and synthetics	42.5	43.1	43.4
Drugs	41.8	41.7	41.1
Soap, cleaners, and toilet goods	40.8	40.1	40.2
Paints and allied products	41.9	41.8	41.9
Industrial organic chemicals	45.2	44.6	43.8
Agricultural chemicals	44.1	43.4	43.3
Miscellaneous chemical products	42.4	42.4	42.1
Petroleum and coal products	44.6	44.3	44.4
Rubber and miscellaneous plastics products	41.1	41.4	41.7

a For production workers in domestic employment. **Source:** Department of Labor

EMPLOYMENT OF SCIENTISTS, ENGINEERS: Growth continues for chemical industry as a whole

Thousands[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Total, all industry	731.7	720.2	708.6	695.8	671.0	622.5	584.1	540.9	509.8	487.8	450.6
Chemicals and allied products	78.4	77.6	75.8	75.2	75.8	71.1	69.8	67.3	61.6	54.7	51.4
Drugs and medicines	33.0	34.0	33.0	32.6	31.8	30.8	30.8[b]	28.2	25.6	23.3	21.6
Industrial chemicals	23.0[b]	23.1[b]	22.5[b]	22.4[b]	24.9	23.5	25.6	26.6	25.9	21.6	20.9
Other chemicals	22.4	20.5	20.3	20.2	19.1	16.7	13.4	12.1	10.1	9.8	8.9
Petroleum refining and extraction	10.2	10.3	9.5	9.9	10.4	13.5	13.3	14.7	15.6	13.0	10.8

a Full-time equivalent number of R&D scientists and engineers in industry, as of January of each year. b Partly estimated. **Source:** National Science Foundation

3 Employment in the U.S. Chemical Industry

CHEMICAL EMPLOYMENT: Falloff returns employment to 1987 levels at major companies

Thousands	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Air Products	14.0	14.1	13.3	12.1	16.6	18.7	17.7	16.7	18.9	16.2	15.8
American Cyanamid	32.0	35.4	35.5	34.3	34.5	36.4	38.2	38.7	40.2	41.8	42.6
Betz Laboratories	3.7	3.4	3.1	2.0	2.6	2.5	2.5	2.3	2.2	2.2	2.1
Cabot Corp.	6.0	5.5	5.2	5.1	6.6	7.7	7.5	7.2	7.5	7.7	7.6
Chemed	6.1	5.7	5.6	4.8	4.8	4.3	4.3	4.1	3.5	3.6	3.6
Crompton & Knowles	1.8	1.7	1.6	1.3	1.3	2.3	2.3	2.4	2.3	2.5	2.8
Dow Chemical	62.1	62.1	55.5	53.1	51.3	53.2	49.8	54.5	56.6	63.8	56.8
Ethyl	5.7	5.5	10.4	10.0	10.5	10.5	11.0	13.0	14.0	14.5	15.0
H. B. Fuller	5.6	5.5	5.2	4.6	4.5	4.4	4.3	4.1	4.0	3.3	3.4
W. R. Grace	49.0	46.4	45.7	39.4	41.4	116.9	102.6	95.5	82.2	89.0	92.0
Hercules	19.9	23.3	22.7	23.2	25.1	25.4	26.3	24.2	24.5	25.9	26.1
Imcera Group	9.6	6.9	6.9	12.9	13.9	8.7	9.0	8.4	8.4	10.6	10.6
International Flavors	4.2	4.2	4.2	4.1	3.8	3.7	3.7	3.7	3.6	3.6	3.6
Lubrizol	5.2	5.3	4.8	4.8	4.8	5.2	4.2	4.2	4.3	4.2	4.2
Monsanto	41.1	42.2	45.6	49.7	51.7	56.1	50.8	48.8	52.2	57.4	61.8
Nalco Chemical	5.9	5.5	5.4	5.1	4.9	5.1	4.8	4.6	4.6	4.7	4.3
Olin	15.2	15.4	16.4	14.1	13.2	14.9	17.8	18.2	17.5	20.3	21.0
PPG Industries	35.1	35.5	36.3	36.8	36.5	37.5	37.7	37.0	37.0	36.6	37.3
Rohm & Haas	12.9	13.0	12.4	12.0	12.1	11.8	11.9	11.4	11.5	13.5	13.2
Stepan	1.3	1.2	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8
Union Carbide	38.8	46.0	44.0	43.1	50.3	91.5	98.4	99.5	103.2	110.3	116.1
TOTAL EMPLOYEES	375.2	383.7	380.8	373.6	391.3	517.7	505.7	499.3	499.1	532.6	540.6
ANNUAL CHANGE	-2.2%	0.8%	1.9%	-4.5%	-24.4%	2.4%	1.3%	0.1%	-6.3%	-1.5%	0.8%
SALES PER EMPLOYEE ($ thousands, current)	$203.3	$189.5	$179.3	$160.7	$135.8	$114.6	$115.8	$110.4	$107.9	$109.6	$102.0
SALES PER EMPLOYEE ($ thousands, constant 1982[a])	$183.3	$153.9	$154.0	$151.0	$132.5	$110.5	$112.6	$110.1	$107.9	$111.4	$114.5

Note: Data are not restated for acquisitions, divestitures, or similar developments. a Based on producer price index for chemicals and allied products. Source: Company data

WAGES: Organic chemical workers are highest paid in chemical industry

	Hourly earnings[a]				Weekly earnings[a]			
	1990	1989	1988	1987	1990	1989	1988	1987
All manufacturing	$10.84	$10.47	$10.18	$ 9.91	$442.27	$429.27	$417.99	$406.31
Chemicals and allied products	13.54	13.09	$12.71	12.37	576.80	555.02	536.36	523.25
Industrial inorganic chemicals	14.67	14.19	13.83	13.57	629.34	605.91	590.54	574.88
Plastics materials and synthetics	14.02	13.44	13.06	12.60	595.85	579.26	562.80	543.06
Drugs	12.87	12.51	12.07	11.62	537.97	521.67	496.08	483.39
Soap, cleaners, and toilet goods	11.76	11.28	11.05	10.90	479.81	452.33	444.21	447.99
Paints and allied products	12.01	11.66	11.24	10.84	503.22	484.39	470.96	452.03
Industrial organic chemicals	15.97	15.65	15.30	14.89	721.84	697.99	670.14	656.19
Agricultural chemicals	13.58	12.79	12.35	11.92	598.88	555.09	534.76	510.18
Miscellaneous chemical products	12.30	11.92	11.54	11.36	521.52	505.41	485.83	471.44
Petroleum and coal products	16.23	15.41	14.97	14.58	723.86	682.66	664.67	641.52
Rubber and miscellaneous plastics products	9.79	9.47	9.19	8.98	402.37	392.06	383.22	373.71

a For production workers in domestic employment. Source: Department of Labor

Productivity drops for chemical industry

Productivity fell and unit labor costs rose for the chemical industry last year.

Revised government production data for chemicals and allied products has cast a new and poorer light on chemical productivity for the past few years. According to the revised data, productivity for chemicals and allied products was essentially flat between 1988 and 1989, instead of increasing 2.3% as previously reported.

Production of chemicals increased just 1.5% in 1990 over the prior year, but aggregate production workhours rose faster at 2.8%. This caused a decline in the productivity index of 1.3%.

At the same time, hourly production wages for chemicals and allied products rose 3.5% from 1989. This caused unit labor costs to increase 4.8%, making 1990 the third straight year that this index has been up.

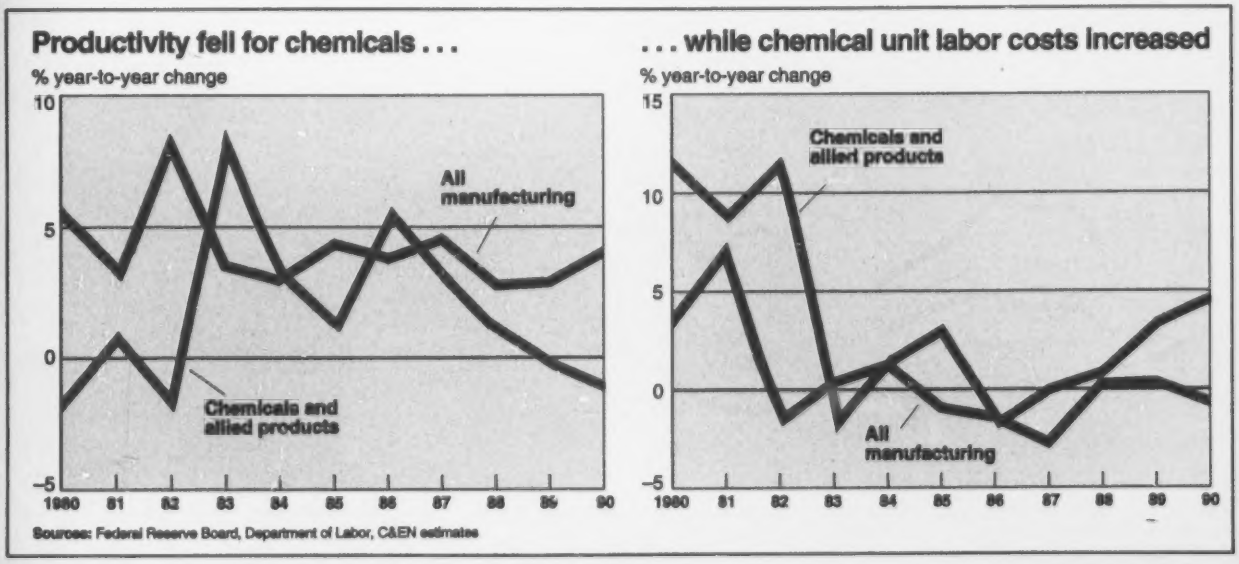
The chemical industry lagged behind all manufacturing last year in productivity. As a result of a nearly 1% increase in production, coupled with a 2.9% decline in aggregate workhours, productivity for the broad manufacturing sector increased 4.0% in 1990 over the year-earlier level.

All manufacturing industries also did much better than chemicals and allied products in terms of the cost of production. While productivity, or unit output per workhour, was rising for all manufacturing, hourly production wages were increasing at a lower 3.4%. As a result, the index for unit labor costs declined 0.9%, a much better performance than the chemical industry's 4.8% rise.

PRODUCTIVITY: Modest growth in chemical industry keeps labor costs relatively low

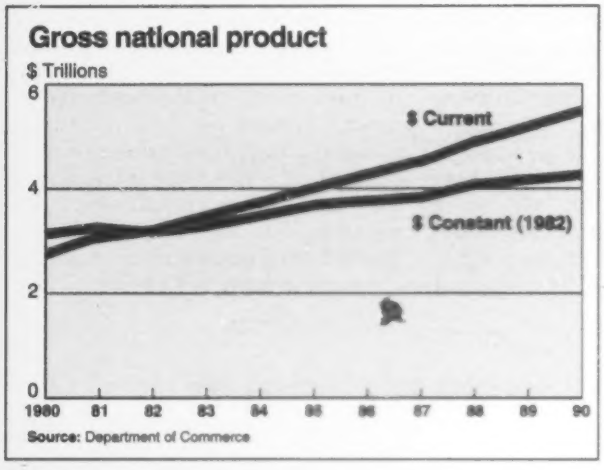
Indexes, 1987 = 100	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
CHEMICALS AND ALLIED PRODUCTS											
Production	110.1	108.5	105.4	100.0	94.6	91.4	91.4	87.5	81.8	89.2	87.8
Workhours	110.0	107.0	103.8	100.0	97.8	99.4	100.3	99.2	100.5	107.4	106.7
Productivity[a]	100.1	101.4	101.5	100.0	96.7	92.0	91.1	88.2	81.4	83.1	82.3
Hourly production wages	109.5	105.8	102.3	100.0	96.7	93.6	89.8	85.7	80.6	73.7	67.2
Unit labor costs[b]	109.3	104.3	100.8	100.0	100.0	101.7	98.6	97.2	99.0	88.7	81.7
ALL MANUFACTURING											
Production	109.9	108.9	105.8	100.0	94.3	91.6	89.3	80.9	76.6	80.3	78.8
Workhours	99.9	102.9	102.9	100.0	98.5	99.7	101.5	94.4	93.1	104.8	105.6
Productivity[a]	110.0	105.8	102.8	100.0	95.7	91.9	88.0	85.7	82.8	76.6	74.6
Hourly production wages	109.7	106.1	102.9	100.0	98.3	95.9	92.8	89.3	86.0	80.9	73.6
Unit labor costs[b]	99.7	100.3	100.1	100.0	102.7	104.3	105.4	104.2	103.9	105.6	98.7

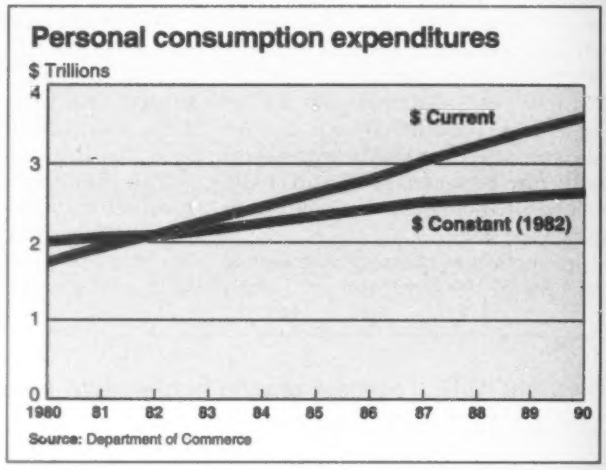
a Productivity is output per workhour, calculated by dividing indexes for production by indexes for workhours of production employees. b Unit labor costs are labor costs per unit of output, calculated by dividing indexes for wages by indexes for output per workhour. **Sources:** Federal Reserve Board, Department of Labor, C&EN estimates



Sources: Federal Reserve Board, Department of Labor, C&EN estimates

Agriculture only growing chemical market



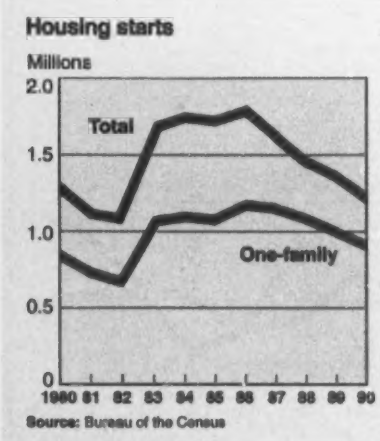


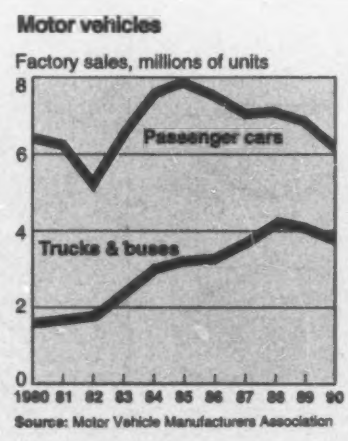
No industry can long outperform its best customers. A glance at the graphs on these two pages is all that's needed to see why 1990 was a soft year for the chemical industry. The U.S. economy overall showed little growth beyond inflation last year, and most major markets for chemicals either held steady or declined.

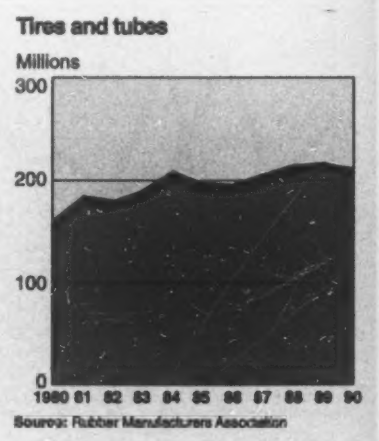
As measured by the gross national product, the U.S. economy outpaced inflation by less than 1% in 1990. Personal consumption expenditures, another broad indicator of overall economic health, also rose by less than 1% in real terms last year. And such growth as there was occurred in the early part of the year. Both GNP and personal consumption declined in the fourth quarter of 1990, a decline that continued in the first quarter of 1991. Thus, the U.S. economy officially slid into recession as 1990 came to a close. And, because the chemical industry's vast array of products are so widely used, softness in the overall economy translated into declines in the markets for chemicals.

For some of the most important chemical markets, 1990 was only the most recent in a string of poor years. New housing—a major market for plastics, synthetic fibers, and coatings—has been declining since 1986. Last year saw housing starts fall 14% to their lowest level since the recession year of 1982.

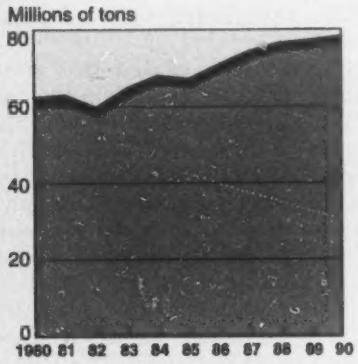
Sales of U.S.-made automobiles also have been declining steadily in recent years, and 1990 continued the





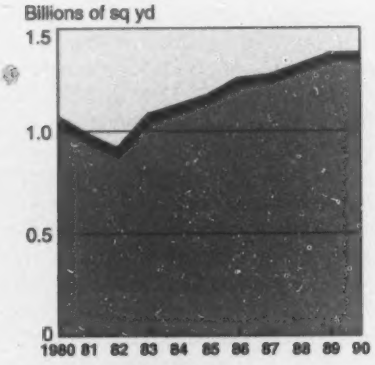


Paper and paperboard



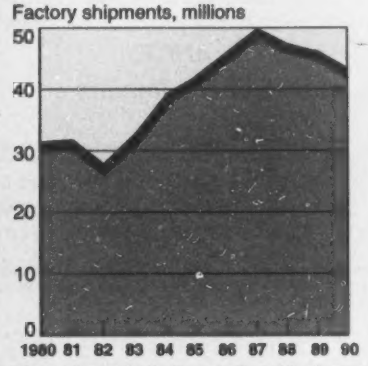
Source: American Paper Institute

Floor coverings



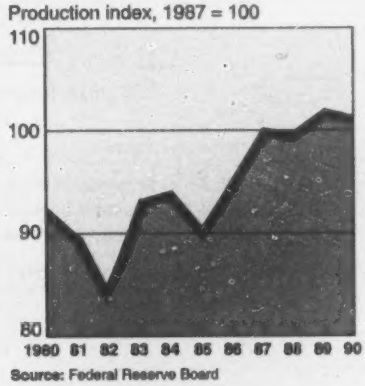
Source: Bureau of the Census

Major home electrical appliances



Source: Association for Home Appliance Manufacturers

Textile mill products

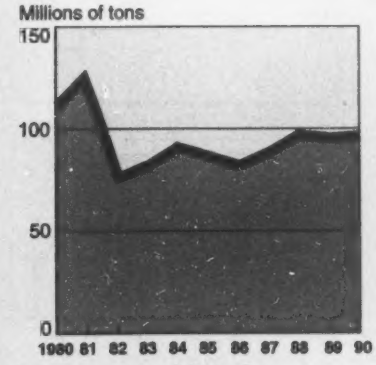


Source: Federal Reserve Board

trend. Sales of passenger cars dropped 11% last year, to just over 6 million units. These sales have fallen 24% from their 1985 levels. Even truck and bus sales, which held up better than cars did against foreign competition through most of the 1980s, slipped 8% in 1990.

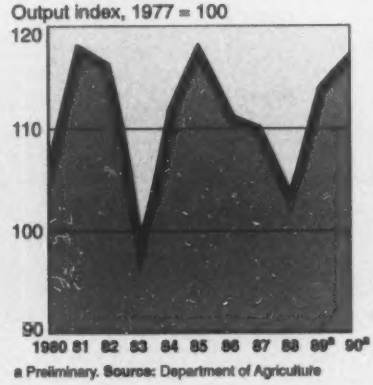
Agricultural production, on the other hand, posted a 3% increase in 1990, led by near record wheat production. Agricultural production is up for the second year in a row, and these two increases bring it back to nearly 1985 levels. Wheat acreage is expected to decline next year, while plantings of cotton, corn, and other feedgrains will be up. The overall effect may be a slight decline in fertilizer use.

Steel



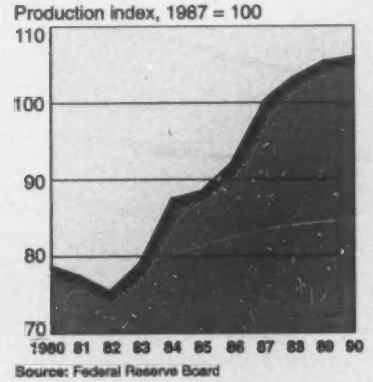
Source: American Iron & Steel Institute

Agricultural production



a Preliminary. Source: Department of Agriculture

Furniture and fixtures



Source: Federal Reserve Board

Chemical trade flourished as trade talks stall

Trade officials in the U.S. chemical industry concentrated their attention last year on the ill-fated Uruguay round of multilateral trade talks. These trade negotiations, held under the auspices of the General Agreement on Tariffs & Trade (GATT), fell apart in Brussels last December and now are struggling to regain their momentum.

Trade experts also spent a lot of time analyzing the consequences for the chemical industry of a possible free trade agreement that would include Mexico and Canada in a North American free trade area.

But despite the emphasis on trade politics and policy, chemical trade went on with a flourish last year. World chemical trade, measured as exports, increased 12% to $295 billion. That's a much larger gain than the 4% advance chalked up in 1989.

It's unlikely, however, that chemical trade grew that much on a volume basis. Although the U.S. dollar has been becoming stronger this year, it weakened against most major foreign currencies in 1990. It declined 6.8% against the Japanese yen, 8.9% against the German deutsche mark, and a hefty 17% against the British pound. As a result, world chemical trade measured in dollars gives an inflated view of actual growth.

The U.S. chemical industry, meanwhile, chalked up another record trade surplus of $16.5 billion. This new record came on the strength of almost $39 billion in chemical exports, up 6.9% over 1989. Chemical import growth, however, was even stronger. Imports advanced 8.3% to $22.5 billion.

Even the overall U.S. trade deficit dropped—for the third successive year—to $101 billion. The reason: Total U.S. exports advanced 8.2%, while total U.S. imports increased only 4.7%.

U.S. TOTAL TRADE BALANCE:
Deficit continues to shrink

$ Billions	1990	1989	1988	1980
Total exports	$ 394.0	$ 364.3	$ 322.4	$ 200.6
Total imports	495.0	472.9	440.9	240.8
Trade balance	−101.0	−108.6	−118.5	−40.2

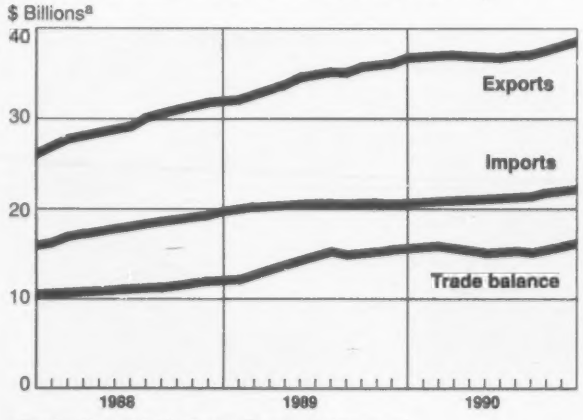
Source: Department of Commerce

U.S. CHEMICAL TRADE BALANCE:
Surplus increases despite strong imports

$ Millions	1990	1989	1988	1980
Chemical exports	$38,983	$36,485	$31,909	$20,740
Chemical imports	22,468	20,752	20,326	8,594
Chemical trade balance	16,515	15,733	11,583	12,146

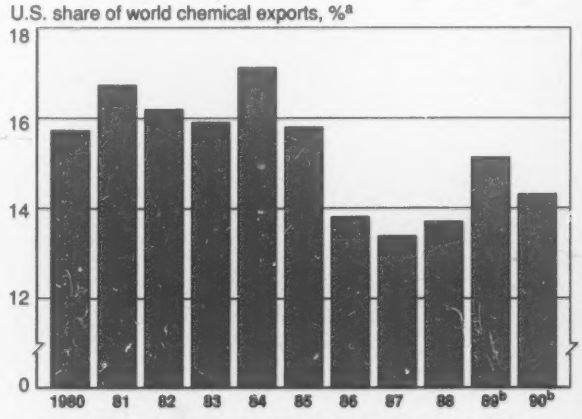
Note: Data for 1990, 1989, and 1988 have been revised according to SITC (Standard International Tariff Classification) revision 3. Earlier data have not been revised. **Source:** Department of Commerce

U.S. chemical trade balance inches up . . .



a Running 12-month totals. **Source:** Department of Commerce

. . . although export market share drops



a U.S. chemical exports as a percentage of total world chemical exports less U.S. chemical imports. b C&EN estimates.

U.S. TRADE: Most goes to European Community

$ Millions[a]	1990	1989	1988	1980
U.S. CHEMICAL EXPORTS				
Canada	$ 6,050	$ 4,210	$ 3,751	$ 2,134
Latin America	5,773	5,419	5,083	4,846
European Community	10,509	9,758	8,318	5,149
Eastern Europe	460	409	336	88
Communist Asia	1,054	1,136	1,309	386
Japan	4,582	4,664	3,982	1,964
Middle East	629	543	542	459
Rest of Asia	6,566	6,624	5,712	2,782
Australia	1,247	1,364	1,066	645
Africa	628	702	594	721
Other	1,485	1,656	1,216	1,566
TOTAL	$38,983	$36,485	$31,909	$20,740
U.S. CHEMICAL IMPORTS				
Canada	$ 4,305	$ 3,934	$ 3,841	$ 2,494
Latin America	1,287	1,671	1,354	536
European Community	9,728	9,158	9,066	3,372
Eastern Europe	242	208	219	195
Communist Asia	337	273	230	107
Japan	2,391	2,373	2,399	697
Middle East	355	371	305	58
Rest of Asia	1,267	985	844	163
Australia	344	291	329	206
Africa	90	61	106	62
Other	2,122	1,427	1,633	704
TOTAL	$22,468	$20,752	$20,326	$ 8,594

a U.S. chemical trade data have been revised according to SITC (Standard International Tariff Classification) revision 3 back to 1983. Earlier data have not been revised. **Source:** Department of Commerce

WORLD TRADE: Up 12% last year

$ Millions	1990	1989	1988	1980
CHEMICAL EXPORTS				
World	$295,100[a]	$262,900[a]	$252,713	$140,748
U.S.	38,983	36,485	31,909	20,740
Canada	6,668	6,099	6,230	3,519
EC, 12 countries	162,063	141,989	139,894	78,535
Belgium-Luxembourg	16,515	13,889	13,043	7,422
France	28,173	23,941	23,634	13,249
Germany[b]	49,553	44,187	43,848	24,318
Italy	11,152	10,003	10,170	5,505
Netherlands	20,164	19,494	19,617	11,268
U.K.	23,415	20,189	20,187	12,303
Switzerland	13,749	11,008	11,137	5,680
Japan	15,872	14,776	13,964	6,767
CHEMICAL IMPORTS				
U.S.	$ 22,468	$ 20,752	$ 20,326	$ 8,594
Canada	8,011	7,764	6,577	3,249
EC, 12 countries	142,353	119,037	112,497	60,604
Belgium-Luxembourg	15,125	11,514	10,672	5,972
France	24,894	20,721	19,619	12,169
Germany[b]	29,944	25,387	24,274	13,314
Italy	20,260	17,182	16,081	7,993
Netherlands	14,224	11,539	10,828	6,393
U.K.	19,274	17,091	16,583	7,310
Switzerland	7,928	6,679	6,731	3,648
Japan	16,045	15,948	14,830	6,202

a C&EN estimates. b Data prior to 1990 are for West Germany only. **Sources:** United Nations, Organization for Economic Cooperation & Development, European Community, individual government agencies

U.S. TRADE, BY PRODUCTS: Organics account for more than a fourth of chemical exports

	Chemical exports				Chemical imports			
$ Millions[a]	1990	1989	1988	1980	1990	1989	1988	1980
Organic chemicals	$10,400	$10,609	$ 9,704	$5,697	$ 7,392	$ 7,042	$ 7,250	$2541
Plastics in primary form	6,428	5,727	5,503	3,884	1,974	1,687	1,373	647
Medicinals and pharmaceuticals	4,103	3,660	3,262	1,932	2,500	2,086	1,849	509
Inorganics	3,816	4,319	4,289	2,939	3,234	3,231	3,147	2314
Plastics in nonprimary form	2,633	2,202	2,001	b	1,774	1,629	1,574	b
Fertilizers, manufactured	2,574	2,821	1,199	2,265	955	999	991	1105
Essential oils and perfume materials	1,963	1,469	1,126	806[c]	1,323	1,165	1,175	374[c]
Dyeing, tanning, and coloring materials	1,588	1,097	1,100	490	1,288	1,133	1,302	284
Other	5,478	4,583	3,725	2,707	2,028	1,780	1,665	820
TOTAL	$38,983	$36,485	$31,909	$20,740	$22,468	$20,752	$20,326	$8594

a U.S. chemical trade data have been revised according to SITC (Standard International Tariff Classification) revision 3 back to 1983. Earlier data have not been revised. b No such classification in 1980. c Included cleansing and polishing materials in 1980. **Source:** Department of Commerce

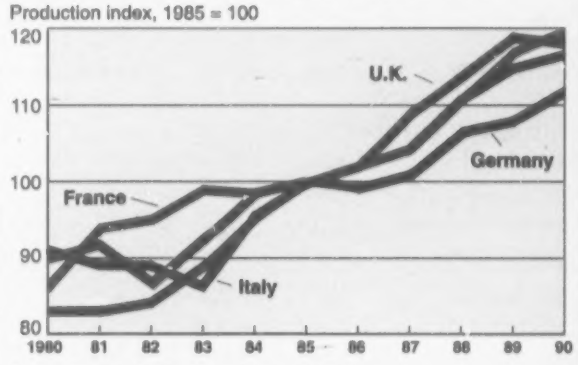
Slowdown hits West European chemicals

Business slowed down for the West European chemical industry in 1990. Only in Germany, where markets were buoyed up by demand from recently re-unified eastern states, did companies continue the growth of previous years.

Although the dollar figures show healthy growth, much of that is due to exchange rate fluctuations; in local currencies, growth has been much more modest. Chemical output rose 2% in volume in 1990, considerably less than in 1989. Pharmaceuticals and detergents showed some production strength, but output was weak for fertilizers, organics, and fibers.

Results in 1990 showed the painful turn from a solidly profitable year in 1989 to one marked by rising oil and raw materials prices only incompletely offset by producers' price increases. The inexorable result: lower profit margins throughout the industry. However, chemical companies maintained capital spending programs.

Chemical output slowing only in U.K.



Source: European Chemical Industry Council (CEFIC)

CHEMICAL INDUSTRY TRENDS: Sales in U.S. dollars rebound after a lackluster 1989

$ Billions (U.S.)	1990	1989	1988	1987	1986
GERMANY					
Sales	$100.6	$ 85.2	$ 85.7	$ 78.0	$ 64.5
Exports	52.3	45.7	45.5	40.2	33.2
Imports	32.8	27.3	25.6	22.6	18.8
Capital spending	7.7	6.1	6.0	5.3	3.5
Production index[a]	112.4	109.4	106.5	101.1	99.1
Price index[a]	93.8	95.2	92.4	91.1	94.2
Employees (thousands)	592	582	575	572	567
FRANCE[b]					
Sales	$ 64.2	$ 54.2	$ 53.5	$ 47.4	$ 40.7
Exports	26.7	22.6	21.9	19.0	15.7
Imports	23.5	19.4	18.2	15.4	12.5
Capital spending	4.2	3.1	2.9	2.5	1.9
Production index[a]	120.3	118.2	111.4	104.1	101.0
Price index[a]	103.2	103.2	98.8	96.3	97.5
Employees (thousands)	263	264	257	268	268
U.K.[b]					
Sales	$ 50.6	$ 44.7	$ 44.0	$ 36.9	$ 30.6
Exports	23.7	20.5	20.2	17.3	14.3
Imports	19.3	17.1	16.6	13.7	11.0
Capital spending	3.3	3.1	3.1	2.3	1.9
Production index[a]	118.2	119.3	113.9	109.0	101.1
Price index[a]	121.7	116.4	111.5	105.8	101.4
Employees (thousands)	317	323	320	336	336

$ Billions (U.S.)	1990	1989	1988	1987	1986
ITALY					
Sales	$ 51.6	$ 44.2	$ 43.8	$ 37.5	$ 30.7
Exports	12.9	11.5	10.9	9.3	7.8
Imports	21.6	18.4	17.1	14.7	12.0
Capital spending	2.9	2.4	2.1	1.8	1.3
Production index[a]	117.1	115.0	112.5	103.6	101.4
Price index[a]	111.5	110.7	107.5	100.4	97.3
Employees (thousands)	217	220	223	225	230
SPAIN[c]					
Sales	$ 40.3	$ 32.5	$ 30.4	$ 25.8	$ 20.7
Exports	6.2	5.2	4.9	4.2	3.1
Imports	10.4	8.6	7.6	6.3	4.7
Capital spending	1.0	0.9	0.7	0.5	0.4
Production index[a]	132.5	128.6	122.5	112.4	105.0
Price index[a]	112.1	108.3	104.6	102.5	101.0
Employees (thousands)	240	240	239	239	239
BELGIUM[b,c,d]					
Sales	$ 28.1	$ 23.4	$ 22.7	$ 19.8	$ 17.2
Exports	20.7	17.3	16.4	14.7	12.2
Imports	17.4	14.3	13.5	10.7	8.6
Capital spending	2.7	1.8	1.6	1.0	0.7
Production index[a]	132.3	124.9	120.2	110.6	102.6
Price index[a]	98.8	102.1	96.5	94.0	97.7
Employees (thousands)	97	95	92	91	91

$ Billions (U.S.)	1990	1989	1988	1987	1986
NETHERLANDS					
Sales	$ 26.3	$ 22.4	$ 22.4	$ 19.5	$ 16.0
Exports	24.1	22.1	21.8	19.0	15.7
Imports	14.2	15.2	12.6	11.5	9.5
Capital spending	2.4	2.0	1.5	1.5	1.2
Production index[a]	120.0	118.0	112.0	104.0	100.0
Price index[a]	89.0	92.0	88.0	87.0	85.4
Employees (thousands)	93	93	92	91	91
SWITZERLAND[b]					
Sales	$ 15.4	$ 12.6	$ 12.7	$ 11.5	$ 9.3
Exports	13.3	10.9	10.8	9.8	7.9
Imports	7.6	6.6	6.4	5.6	4.7
Production index[a]	119.6	119.0	109.4	105.3	102.1
Price index[a]	97.9	93.0	91.9	90.8	97.3
Employees (thousands)	73	72	70	69	68
SWEDEN					
Sales	$ 8.4	$ 7.3	$ 7.5	$ 6.3	$ 5.0
Exports	4.3	3.7	3.6	3.0	2.5
Imports	5.2	4.7	4.6	3.9	3.2
Capital spending	0.7	0.5	0.5	0.5	0.4
Production index[a]	119.5	115.0	119.6	106.3	99.3
Price index[a]	118.0	116.0	110.5	103.2	101.6
Employees (thousands)	41	42	43	45	42
AUSTRIA[c]					
Sales	$ 8.0	$ 7.0	$ 7.0	$ 6.1	$ 3.5
Exports	3.5	3.0	3.0	2.4	1.9
Imports	4.9	3.9	3.8	3.4	2.7
Capital spending	0.9	0.6	0.6	0.5	0.5
Production index[a]	105.4	103.8	100.0	87.3	100.8
Employees (thousands)	57	57	56	55	35
PORTUGAL					
Sales	na	$ 4.6	$ 4.8	$ 1.7	$ 1.5
Exports	$ 1.0	0.9	0.8	0.6	0.5
Imports	2.8	2.1	1.9	1.8	0.9
Production index[a]	na	172.2	163.2	151.9	112.0
Employees (thousands)	na	64	51	51	51

$ Billions (U.S.)	1990	1989	1988	1987	1986
IRELAND[b]					
Sales	$ 4.7	$ 3.7	$ 3.1	$ 2.5	$ 2.2
Exports	3.8	3.0	2.5	1.9	1.7
Imports	2.6	2.2	2.0	1.7	1.4
Production index[a]	149.0	144.8	124.1	108.1	99.2
Price index[a]	92.5	96.8	93.4	91.7	96.8
Employees (thousands)	14	13	12	12	12
DENMARK					
Sales	$ 4.1	$ 3.4	$ 3.6	$ 3.7	$ 2.8
Exports	3.3	2.8	2.7	2.4	1.9
Imports	3.7	3.1	3.1	2.8	2.4
Capital spending	0.3	0.3	0.3	0.3	0.2
Production index[a]	111.0	111.0	107.0	105.4	108.0
Price index	112.0	109.0	104.0	99.0	97.4
Employees (thousands)	27	27	26	26	26
FINLAND					
Sales	na	$ 4.0	$ 3.5	$ 3.6	$ 3.1
Exports	$ 1.7	1.5	0.6	0.6	1.2
Imports	2.9	2.6	1.0	1.1	2.1
Capital spending	na	0.4	0.4	0.5	0.4
Production index[a]	116.8	120.2	113.4	92.1	102.1
Price index[a]	109.1	107.8	102.4	95.0	95.5
Employees (thousands)	na	20	20	24	24
NORWAY					
Sales	$ 3.6	$ 3.1	$ 3.1	$ 2.9	$ 2.3
Exports	2.2	1.9	1.9	1.6	1.3
Imports	2.2	1.9	1.9	1.6	1.4
Capital spending	na	0.2	0.2	0.2	0.2
Production index[a]	114.0	108.6	103.0	103.0	100.0
Price index[a]	120.3	122.0	114.0	106.0	101.5
Employees (thousands)	15	14	14	15	15

a 1985 = 100. b Excludes fibers. c Includes rubber and plastics processing. d Includes Luxembourg for exports and imports. **na** = not available. **Sources:** National agencies, European Chemical Industry Council (CEFIC)

NOTE ON CURRENCY CONVERSION

For monetary statistics in this section, European currencies were converted to U.S. dollars by the following conversion rates:

	$1.00 (U.S.) is equivalent to:				
	1990	1989	1988	1987	1986
Austria (schillings)	11.37	13.23	12.35	12.65	15.27
Belgium (francs)	33.42	39.40	36.77	37.33	44.67
Denmark (crowns)	6.19	7.31	6.73	6.84	8.09
Finland (marks)	3.82	4.29	4.18	4.40	5.07
France (francs)	5.45	6.38	5.96	6.01	6.93
Germany (marks)	1.62	1.88	1.76	1.80	2.17
Ireland (pounds)	0.603	0.705	0.654	0.672	0.745
Italy (lire)	1198	1372	1302	1297	1491
Netherlands (guilders)	1.82	2.12	1.98	2.03	2.45
Norway (crowns)	6.26	6.90	6.52	6.74	7.39
Portugal (escudos)	142.6	157.5	144.0	141.0	150.0
Spain (pesetas)	101.93	118.38	116.49	123.48	140.05
Sweden (crowns)	5.92	6.45	6.13	6.34	7.14
Switzerland (francs)	1.39	1.64	1.46	1.49	1.80
U.K. (pounds)	0.560	0.610	0.562	0.610	0.682

Source: International Monetary Fund

MAN-MADE FIBERS: Overall production of cellulosics holds steady, other fibers fall 7%

Millions of lb	1990		1989		1988		1987		1986		Change, 1989–90	
	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics
Germany	1854	396	1841	394	1817	376	1806	356	1738	354	0%	0%
Italy	1010	79	1412	77	1452	70	1441	64	1430	66	−29	3
Spain	585	79	592	88	590	81	591	78	601	80	−2	−10
Benelux countries	568	117	521	119	385	119	399	109	379	108	9	−2
Turkey	534	20	645	20	592	20	572	18	504	18	−17	0
U.K.	506[a]	266[b]	493[a]	255[b]	515[a]	238[b]	513[a]	208[b]	524[a]	207[b]	3	4
France	343	0	392	4	392	33	382	50	392	45	−13	—
Switzerland	260	0	264	0	255	0	227	0	216	0	−2	—
Ireland	205	0	207	0	176	0	172	0	162	0	−1	—
Portugal	141	1	141	2	128	2	139	2	136	2	0	−50
Austria	84	297	77	301	70	290	68	264	61	271	9	−1
Finland	11	141	7	143	7	132	4	118	3	121	57	−1

a -Includes cellulose acetate filament. b Excludes cellulose acetate filament. **Source:** Comité International de la Rayonne et des Fibres Synthétiques

PRODUCTION: German production holds up best amid overall declines

Millions of lb	1990	1989	1988	1987	Change 1989–90
FRANCE					
Sulfuric acid	8306	9141	8846	8618	−9%
Hydrochloric acid	1488	1525	1507	1427	−2
Chlorine	2956	3185	3121	2971	−7
Sodium hydroxide	3143	3370	3258	3123	−7
Carbon black	556	595	531	511	−7
Ammonia	3257	3249	4031	4466	0
Benzene	1434	1474	1544	1439	−3
Toluene	74	74	104	72	0
Xylenes	na	372	493	284	—
Ethylene	4948	5562	5361	5319	−11
Propylene	3157	3480	3298	3073	−9
Butadiene	619	724	737	677	−15
Formaldehyde	220	221	193	180	0
Polyethylene	2461	2549	2620	2523	−4
Polypropylene	1715	1544	1278	1159	11
Polystyrene	1193	1192	1177	1166	0
Polyvinyl chloride	2265	2350	2237	2039	−4
Synthetic rubber	1151	1300	1251	1184	−12
Nitrogen fertilizers	4655	4373	4343	na	6
Phosphate fertilizers[a]	626	594	707	1209	−12
GERMANY[b,c]					
Sulfuric acid	7390	7165	7186	7260	3
Hydrochloric acid	2005	2107	2160	2179	−5
Nitric acid	4144	4807	5098	5818	−14
Chlorine	7257	7574	7701	7595	−4
Sodium hydroxide	7204	7370	7602	7523	−2
Sodium carbonate	3177	3175	3089	3195	0
Sodium sulfate	389	379	385	361	3
Carbon black	866	884	836	796	−2
Ammonia	3561	4573	4816	5098	−22
Benzene	3231	3443	3536	3316	−6
Toluene	1145	919	1013	884	25
Xylenes	1287	1345	1296	1102	−4
Aniline	na	376	386	309	—
Ethylene	6604	6588	6889	6118	0
Propylene	3914	3819	3396	3467	3
Butadiene	1699	1579	1677	1543	8
Ethylene oxide	1355	1482	1381	1223	−9
Ethylene glycol	457	543	521	536	−16
Propylene oxide	1319	1299	1209	1181	2
Propylene glycol	401	399	427	379	0
***n*-Butanol**	777	741	685	689	5
Acetaldehyde	786	709	789	727	11
Acetic acid	716	701	754	704	2
Ethanol	236	224	228	240	5
Methanol	1635	1535	na	na	7%
Formaldehyde	1497	1534	1505	1341	−2
Phthalic anhydride	501	506	612	522	−1
Polyethylene	3223	3064	3235	2980	5
Polyvinyl chloride	2890	2948	3105	2904	−2
Synthetic rubber	1152	1119	1101	1035	3
Nitrogen fertilizers[d]	1870	1500	na	1674	25
Phosphate fertilizers[e]	185	197	na	na	−6
ITALY[c]					
Sulfuric acid	7281	7084	9478	9590	−7
Nitric acid	2293	2443	2625	2629	−6
Hydrochloric acid	1635	1400	2218	1496	17
Phosphoric acid	544	618	785	843	−12
Chlorine	2242	2349	2385	2294	−5
Sodium hydroxide	2448	2598	2618	2676	−6
Sodium perborate	271	276	242	245	−2
Carbon black	398	446	442	420	−11
Ammonia	3266	3882	3846	3839	−16
Benzene	1390	1447	1368	1311	−4
Toluene	435	338	480	402	29
Xylenes	958	1023	986	1067	−6
Formaldehyde	243	258	277	297	−6
Acetic acid	21	99	145	140	−79
Polyethylene	2019	1937	1822	1691	4
Polystyrene	613	590	627	664	4
Polyvinyl chloride	1312	1801	1740	1380	−27
Nitrogen fertilizers[d]	5356	6210	7176	6999	−14
U.K.					
Sulfuric acid	4402	4744	4967	4797	−7
Hydrochloric acid[e]	358	367	388	384	−3
Chlorine	2073	na	na	2256	—
Benzene	1846	2292	2072	2005	−18
Ethylene	3287	4346	4464	3955	−25
Propylene	1412	1753	2985	1929	−20
Butadiene	430	497	527	509	−16
Titanium dioxide[e]	na	593	586	562	—
Acetone	283	287	280	259	−1
Formaldehyde	176	176	246	250	0
Polyethylene	967[f]	894	716	956	8
Polypropylene	798	671	659	597	19
Polyvinyl chloride	770	736	740	774	5
Synthetic rubber	659	687	688	565	−4

a As P_2O_5. b Data prior to 1990 are for West Germany only. c Data for 1990 are C&EN estimates. d As N. e Manufacturers' sales. f C&EN estimates. na = not available. **Sources:** British Plastics Federation, government agencies for each country

COMPANY RESULTS: Capital spending and R&D remain strong despite generally lower profits

$ Millions	Net sales	Net income	Profit margin[a]	Capital spending	R&D spending	Employees (thousands)
BASF (Germany)						
1990	$28,779.6	$ 683.3	2.4%	$2751.9	$1277.2	134.6
1989	25,328.2	1071.9	4.2	2104.3	1039.4	137.0
1988	24,925.0	813.8	3.2	1985.8	1016.5	134.8
1987	22,354.4	586.1	2.6	1532.2	896.1	133.8
Hoechst (Germany)						
1990	$27,692.6	$1046.9	3.8%	$2098.1	$1658.6	172.9
1989	24,413.8	1133.0	4.6	1700.5	1394.1	169.3
1988	23,275.0	1144.9	4.9	1579.5	1372.7	164.5
1987	20,531.1	848.9	4.1	1330.0	1231.7	167.8
Bayer (Germany)						
1990	$25,705.6	$1174.7	4.6%	$2275.9	$1690.1	171.0
1989	23,031.4	1125.5	4.9	1833.5	1433.5	170.2
1988	22,993.2	1090.3	4.7	1786.9	1397.7	165.7
1987	20,635.0	857.8	4.2	1425.0	1301.7	164.4
ICI (U.K.)						
1990	$23,046.4	$1101.8[b]	4.8%	$1808.9	$1212.5	132.1
1989	21,591.8	1524.6[c]	7.1	1770.5	1047.5	133.8
1988	20,816.7	1567.6[d]	7.5	1443.1	1005.3	130.4
1987	18,234.4	1245.9	6.8	1160.7	755.7	127.8
Rhône-Poulenc (France)						
1990	$14,460.6	$ 356.3	2.5%	$1376.1	$ 972.5	91.6
1989	11,452.7	641.4	5.6	1099.7	662.9	85.6
1988	10,962.1	580.0	5.3	990.1	641.4	79.7
1987	9,344.3	392.7	4.2	830.4	585.4	83.0
Ciba-Geigy (Switzerland)						
1990	$14,174.8	$ 743.2	5.2%	$1480.6	$1475.5	94.1
1989	12,565.9	949.4	7.5	1211.6	1265.2	92.6
1988	12,087.0	907.5	7.5	1106.8	1230.8	88.8
1987	10,579.9	738.3	7.0	918.1	1122.8	86.1
EniChem (Italy)						
1990	$12,570.9	$ (56.7)[e]	—	$1530.9	$ 268.8	49.0
1989	11,185.9	521.9	4.7	1445.5	na	52.7
1988[f]	11,261.1	627.5	5.6	920.1	na	54.7
1987	na	na	na	na	na	na
Norsk Hydro (Norway)						
1990	$ 9,739.9	$ 463.4	4.8%	$1255.8	$ 164.9	33.0
1989	9,612.9	389.4	4.1	1316.8	117.5	32.8
1988	9,206.7	526.7	5.7	1355.2	113.5	39.5
1987	8,086.5	311.0	3.8	1451.0	97.2	39.1
Akzo (Netherlands)						
1990	$ 9,475.8	$ 393.4[g]	4.2%	$ 604.4	$ 489.6	69.8
1989	8,837.8	450.1	5.1	613.2	426.4	70.9
1988	8,374.2	446.0	5.3	641.4	409.0	71.1
1987	7,652.7	354.6[h]	4.6	539.4	362.1	67.4
Sandoz (Switzerland)						
1990	$ 8,897.1	$ 695.7	7.8%	$ 913.7	$ 869.1	52.6
1989	7,620.1	584.1	7.7	656.1	673.2	50.7
1988	6,986.3	521.2	7.5	573.3	624.7	48.0
1987	6,026.2	420.8	7.0	421.5	540.3	44.0
Degussa (Germany)						
1990[i]	$ 8595.7	$ 90.7	1.1%	$ 420.4	$ 282.7	35.0
1989[i]	7636.7	93.1	1.2	282.4	224.5	33.7
1988[i]	7730.1	83.0	1.1	255.3	213.1	32.4
1987[i]	6510.6	67.2	1.0	230.9	150.0	30.8
Solvay (Belgium)						
1990	$ 7637.4	$532.6[j]	7.0%	$1092.2	$ 384.4	45.7
1989	6517.8	524.6[k]	8.0	781.7	304.6	45.1
1988	6,893.3	410.9[l]	6.0	644.5	293.4	44.3
1987	5989.8	325.9[m]	5.4	498.3	247.1	45.0
Roche Group (Switzerland)						
1990	$ 6956.8	$682.0	9.8%	$ 652.5	$1038.8	52.7
1989	5984.1	519.5	8.7	553.7	865.2	50.2
1988	5571.9[n]	439.7[n]	7.4	446.6	828.9	47.2[n]
1987	5171.1	323.5	6.3	348.8	715.8	47.5
DSM (Netherlands)						
1990	$ 5584.6	$445.6[o]	8.0%	$ 719.8	$ 233.5	24.9
1989	5081.1	488.2[p]	9.6	820.8	188.7	30.0
1988	5111.6	399.5[q]	7.8	667.7	181.8	28.6
1987	4422.6	260.6[r]	5.9	431.0	140.4	27.9
Air Liquide (France)						
1990	$ 5305.3	$361.7	6.8%	$ 727.6	$ 265.1	na
1989	4428.1	283.1	6.4	471.6	139.5	27.0
1988	4299.8	265.8	6.2	384.9	121.3	na
1987	3903.5	231.4	5.9	341.8	110.1	na
BOC International (U.K.)						
1990	$ 4721.3	$432.0	9.2%	$ 550.0	$ 111.1	40.0
1989	3785.4	375.9	9.9	565.2	89.5	38.4
1988	3771.4	365.1[s]	9.7	523.5	83.3	38.8
1987	3211.6	273.4[t]	8.5	362.5	61.5	35.5
Nobel Industries (Sweden)						
1990	$ 4459.3	$175.2[u]	3.9%	$ 410.3	na	26.7
1989	3424.5	214.0	6.2	224.7	na	22.2
1988	3488.1	152.3	4.4	176.3	na	22.1
1987	2195.6	98.1[v]	4.5	162.9	na	18.1
Courtaulds (U.K.)						
1990[w]	$ 3413.6	$258.0[x]	7.6%	na	$ 71.4	na
1989[w]	3121.3	206.6[y]	6.6	na	67.0	24.0
1988[w]	2932.4	197.5[z]	6.7	na	60.3	20.8
1987[w]	2452.5	180.3[aa]	7.4	na	na	23.7
Schering Group (Germany)						
1990	$ 3656.2	$159.5	4.4%	$ 318.5	$ 577.0	26.7
1989	3109.0	119.7	3.9	244.1	373.4	25.3
1988	2995.5	89.2	3.0	233.5	358.0	24.7
1987	2611.7	79.4	3.0	220.0	311.7	24.0
Kemira (Finland)						
1990	$ 2979.6	$ 43.7[bb]	1.5%	$ 306.8	na	15.3
1989	2570.7	40.9	1.6	374.1	na	16.0
1988	2207.7	117.4	5.3	345.7	na	14.9
1987	1942.7	64.4	3.3	644.8	na	13.6

Note: All corporate consolidated sales exclude sales of companies owned less than 50%. a Net income as a percentage of sales. b Excludes nonrecurring gain of $94.6 million. c Excludes nonrecurring gain of $208.2 million. d Excludes nonrecurring loss of $78.3 million. e Net loss. f Pro forma. g Excludes nonrecurring loss of $35.4 million. h Excludes nonrecurring gain of $134.6 million. i Fiscal year ends Sept. 30. j Excludes nonrecurring loss of $56.6 million. k Excludes nonrecurring loss of $100.5 million. l Excludes nonrecurring loss of $136.5 million. m Excludes nonrecurring loss of $90.0 million. n Restated to reflect sale of operations. o Excludes nonrecurring gain of $25.8 million. p Excludes nonrecurring gain of $162.7 million. q Excludes nonrecurring loss of $87.9 million. r Excludes nonrecurring loss of $40.4 million. s Excludes nonrecurring loss of $42.2 million. t Excludes nonrecurring loss of $8.2 million. u Excludes nonrecurring net gain of $23.8 million. v Excludes nonrecurring gain of $17.8 million. w Fiscal year ends March 31. x Excludes nonrecurring loss of $123.2 million. y Excludes nonrecurring loss of $68.9 million. z Excludes nonrecurring gain of $218.9 million. aa Excludes nonrecurring loss of $19.7 million. bb Excludes nonrecurring loss of $47.4 million. na = not available.

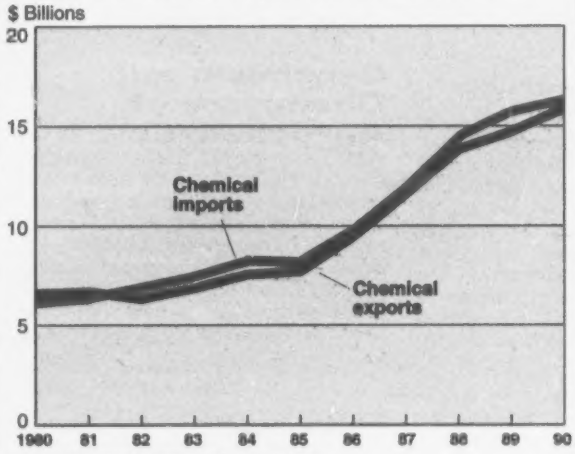
6 Foreign Chemical Industries — Japan

Japanese chemical companies ran into a difficult year in 1990. Although the Japanese economy generally was good last year, rising interest rates started to take their toll as the year wore on. Sharp oil price hikes—the result of the Middle East conflict—also dampened the economy in the second half of the year.

Despite the economic downdraft, chemical demand remained strong, particularly in the petrochemical and plastics sectors. This allowed Japanese ethylene producers to chalk up their fourth consecutive record year, with output topping 5.8 million metric tons.

However, higher feedstock prices took their toll of company profits. Profit margins dropped sharply, particularly in the second half of fiscal 1990.

Japan's chemical trade deficit shrinks



Source: Ministry of International Trade & Industry

INDUSTRY TRENDS: Plastics lead growth

Production index, 1985 = 100	1990	1989	1988	1987	Change 1989–90
All manufacturing	125.6	120.0	113.1	103.2	5%
All chemicals	134.4	128.7	120.4	111.1	4
Inorganic chemicals and pigments	114.3	114.4	108.4	100.9	0
Alkalies and chlorine	120.9	114.7	110.5	103.6	5
Organic chemicals	131.7	128.1	115.9	105.4	3
Petrochemicals	136.7	129.1	118.1	107.6	6
Aromatics	137.3	133.2	115.9	107.1	3
Cyclic intermediates and dyes	143.2	135.3	121.2	110.9	6
Plastics	139.6	130.7	120.6	109.9	7
Synthetic fibers	101.2	97.5	95.4	94.6	4
Synthetic rubber	123.1	116.7	112.2	102.9	6
Fertilizer	85.2	86.6	88.5	91.6	−2
Textile materials	126.8	118.7	117.8	110.7	7
Medicinals and drugs	154.8	147.3	136.2	123.1	5

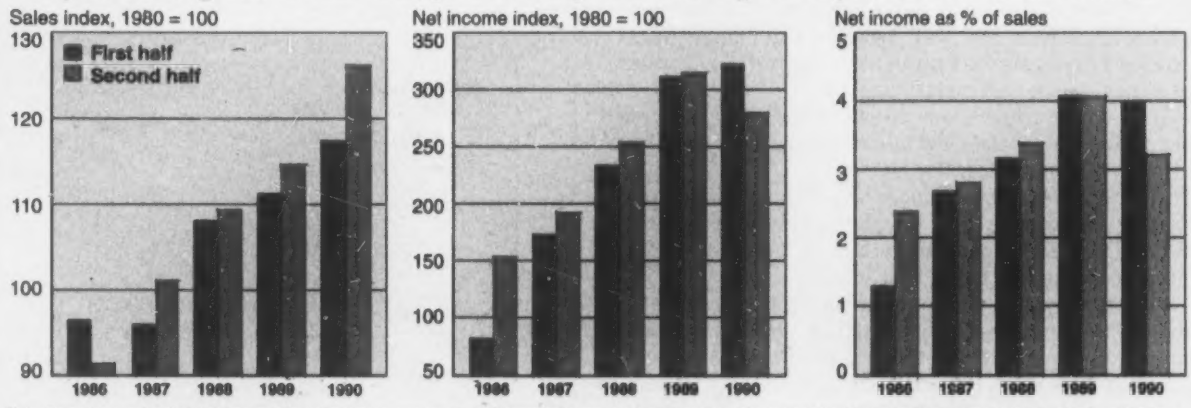
Source: Ministry of International Trade & Industry

PRODUCTION: Up for most chemicals

Thousands of metric tons, unless otherwise indicated	1990	1989	1988	1987	Change 1989–90
INORGANIC CHEMICALS					
Ammonia	1831	1831	1817	1784	0%
Ammonium chloride	246	274	299	332	−10
Ammonium sulfate	1803	1717	1834	1804	5
Calcium carbide	294	344	342	354	−15
Calcium superphosphate	472	454	476	499	4
Carbon black	783	779	720	629	1
Chlorine, liquid	1042	1009	979	911	3
Hydrochloric acid	637	571	565	543	12
Nitrogen, millions of cu m	8299	7856	6940	6452	6
Oxygen, millions of cu m	8787	8384	7707	6878	5
Sodium carbonate	1135	1105	1083	1098	3
Sodium hydroxide	3917	3674	3508	3227	7
Sodium silicate	788	756	721	664	4
Sulfuric acid	6887	6885	6766	6541	0
Titanium dioxide	280	275	258	238	2
ORGANIC CHEMICALS					
Acetaldehyde	384	356	333	285	8
Acetic acid	462	432	402	377	7
Acetone	334	337	289	260	−1
Acrylonitrile	593	611	600	573	−3
Benzene[a]	2768	2672	2374	2226	4
Butadiene	827	827	780	707	0
Butanol	300	291	276	259	3
Caprolactam	509	469	493	470	9
Cyclohexane	629	656	561	557	−4
Dioctyl phthalate	295	293	273	261	1
Ethylene	5810	5602	5057	4585	4
Ethylene dichloride	2660	2464	2301	2051	8
Ethylene glycol	501	548	349	313	−9
Ethylene oxide	674	681	510	484	−1
Methanol	84	82	141	181	2
Octanol	283	285	273	257	−1
Phenol	403	423	358	308	−5
Phthalic anhydride[a]	161	160	171	172	1
Propylene	4215	4036	3682	3370	4
Propylene glycol	298	285	265	236	5
Styrene	2215	1990	1757	1559	11
Terephthalic acid	1338	1200	1150	1048	12
Toluene	1078	1075	1019	1006	0
Toluene diisocyanate	116	104	96	91	12
Urea	776	810	790	729	−4
Xylene	2652	2488	1988	1767	7
PLASTICS					
Phenolic resins	385	375	358	332	3
Polyethylene	2888	2712	2380	2182	7
Polypropylene	1942	1719	1559	1406	13
Polystyrene	2097	1997	1891	1735	5
Polyvinyl chloride	2049	1972	1838	1663	4
SYNTHETIC RUBBER	1426	1352	1299	1192	6

a 'Petroleum-based product only. Source: Ministry of International Trade & Industry

Despite strong sales increase, profitability is declining for Japanese chemical firms



Note: Based on results of 12 leading Japanese chemical companies: Asahi Chemical, Dainippon Ink & Chemicals, Hitachi Chemical, Mitsubishi Kasei, Mitsubishi Petrochemical, Mitsui Toatsu Chemicals, Sekisui Chemical, Showa Denko, Sumitomo Chemical, Takeda Chemical Industries, Teijin, and Toray Industries. The fiscal year for most, but not all, of these companies ends March 31. **Source:** Toyo Keizai Shinposha

COMPANY RESULTS: Earnings drop for many Japanese chemical companies

$ Millions	Net sales	Net income	Profit margin[a]	Total assets	Employees (thousands)
Asahi Chemical Industry[b]					
1990	$6699	$262.4	3.9%	$6895	15.3
1989	6377	241.0	3.8	6468	15.1
1988	6384	219.4	3.4	6410	15.4
1987	5357	141.0	2.6	5241	15.6
Mitsubishi Kasei[c]					
1990	$5321	$128.1	2.4%	$6851	9.1
1989	5307	130.8	2.5	6621	8.9
1988	6132	124.9	2.0	6973	8.8
1987	4360	90.4	2.1	6002	8.9
Sumitomo Chemical[d]					
1990	$4950	$114.5	2.3%	$5587	7.8
1989	4363	145.7	3.3	5730	7.7
1988	4341	116.4	2.7	5806	7.7
1987	3609	78.6	2.2	4615	7.7
Takeda Chemical Industries[b]					
1990	$3833	$265.9	6.9%	$5020	11.0
1989	4262	271.7	6.4	5280	10.9
1988	4567	269.4	5.9	5358	10.8
1987	3777	219.6	5.8	4628	10.8
Sekisui Chemical[b]					
1990	$4144	$179.6	4.3%	$4236	5.6
1989	4018	171.6	4.3	3414	5.4
1988	3936	141.4	3.6	2919	5.2
1987	3089	84.6	2.7	2555	5.3
Toray Industries[b]					
1990	$4040	$193.4	4.8%	$5189	10.3
1989	3982	227.7	5.7	5362	9.6
1988	4317	134.7	3.1	5528	10.0
1987	3780	113.5	3.0	4854	10.6

$ Millions	Net sales	Net income	Profit margin[a]	Total assets	Employees (thousands)
Showa Denko[d]					
1990	$3934	$ 78.2	2.0%	$5439	5.3
1989	3811	97.1	2.6	4455	5.1
1988	3679	71.3	1.9	4299	5.1
1987	2908	38.8	1.3	3881	5.0
Dainippon Ink & Chemicals[b]					
1990	$3489	$ 57.3	1.6%	$4052	7.2
1989	3407	62.4	1.8	3999	6.9
1988	3440	62.2	1.8	4074	6.7
1987	2923	43.7	1.5	3366	6.6
Mitsui Toatsu Chemicals[b]					
1990	$3039	$ 69.1	2.3%	$4301	5.5
1989	2997	87.3	2.9	3963	5.4
1988	3082	83.5	2.7	3936	5.4
1987	2543	43.5	1.7	3004	5.6
Mitsubishi Petrochemical[b]					
1990	$3000	$178.5	6.0%	$4220	3.3
1989	2795	227.8	8.2	4376	3.0
1988	2654	160.0	6.0	3493	2.9
1987	2022	64.7	3.2	2843	2.8
Teijin[b]					
1990	$2279	$138.1	6.1%	$4023	5.7
1989	2217	154.9	7.0	4015	5.7
1988	2438	136.5	5.6	3823	5.8
1987	2167	109.3	5.0	3391	6.2
Hitachi Chemical[b]					
1990	$2099	$ 30.7	1.5%	$1394	5.3
1989	2052	31.7	1.5	1279	5.1
1988	2158	28.2	1.3	1261	5.0
1987	1748	20.7	1.2	1056	4.9

Note: Monetary statistics are converted from yen to U.S. dollars on the basis of $1.00 equals: 1990, 144.8 Y; 1989, 137.9 Y; 1988, 128.1 Y; 1987, 142.9 Y. Year-to-year changes in sales, net income, and assets are affected by these fluctuations in the currency exchange rate. a Net income as a percentage of sales. b Fiscal year ends March 31. c Fiscal year ends March 31 for 1990, 1989, and 1988, Jan. 31 for 1987. d Fiscal year ends Dec 31. **Sources:** Toyo Keizai Shinposha, Nihon Keizai Shimbon America

6 Foreign Chemical Industries — Canada

Sales and profits of Canadian chemical companies slipped last year as the country's recession ate into volume, and prices for many chemicals dropped. Inorganics were especially hard hit. Some of the trouble spots included chemicals that move into the fertilizer, pulp and paper, and construction markets.

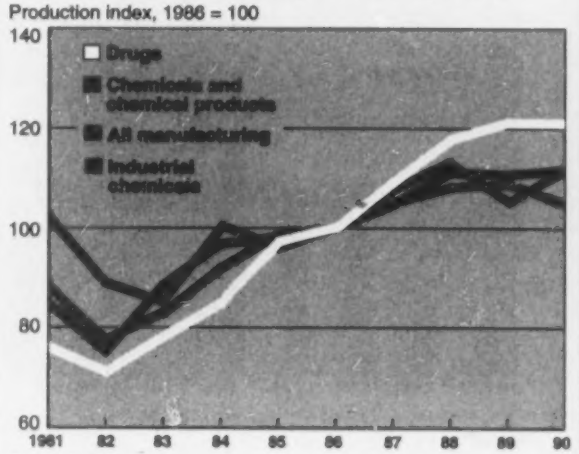
But it could have been worse. These rough spots were more than offset by advances in petrochemical and plastics production.

In some cases, the advances were substantial. Total polyethylene output, for instance, was up a healthy 14%, while high-density polyethylene production registered a strong 20% gain.

New capacity that came on stream last year explains some of the increase in production. But only some. Strong export markets are the other explanation.

Canadian chemical exports increased 7.7% (in Canadian dollars) last year to $6.6 billion (U.S.). Chemical shipments to the U.S., which account for almost 70% of Canadian chemical exports, were especially strong. They were up 13% (in Canadian dollars) to $4.6 billion (U.S.).

Chemical output barely inches upward



Source: Statistics Canada

Note on currency conversion: Monetary statistics in this section have been converted from Canadian dollars to U.S. dollars on the basis of $1.00 U.S. equals: 1990, $1.667 Canadian; 1989, $1.184 Canadian; 1988, $1.231 Canadian; 1987, $1.322 Canadian; 1986, $1.391 Canadian; 1985, $1.362 Canadian.

COMPANY RESULTS: Most profits dip

$ Millions (U.S.)	Sales	Net income[a]	Profit margin[b]	Capital expenditures	Employees (thousands)
Celanese Canada					
1990	$ 312.5	$ 35.4	11.3%	$ 20.7	1.8
1989	335.0	40.8	12.2	14.5	1.9
1988	330.8	39.7	12.0	19.9	2.1
1987	265.5	21.5	8.1	16.1	2.1
Du Pont Canada					
1990	$1209.4	$ 53.5	4.4%	$154.6	4.3
1989	1196.9	66.4	5.6	91.3	4.1
1988	1119.6	81.2	7.3	86.6	4.0
1987	1021.4	68.5	6.7	47.9	4.2
Nova Corp. of Alberta					
1990	$4059.2	$158.7	3.9%	$822.8	9.5
1989	4088.3	157.1	3.8	621.7	13.0
1988	3202.1	321.8	10.0	356.7	11.3
1987	1755.4	170.1	9.7	151.2	7.0
Union Carbide Canada					
1990	$ 419.1	$ −4.0	na	$ 56.5	2.5
1989	436.0	36.0	8.3%	41.7	2.6
1988	461.3	34.3	7.4	45.0	2.8
1987	318.4	19.4	6.1	26.2	2.3

a Excludes extraordinary gains and losses. b Net income as a percentage of sales. na = not available.

PRODUCTION: Inorganics weak, plastics do well

Thousands of metric tons	1990	1989	1988	1987	Change 1989–90
INORGANIC CHEMICALS					
Ammonia	3602	4054	4012	3512	−11.2%
Ammonium nitrate	1031	1056	990	844	−2.3
Ammonium phosphate	803	952	986	941	−15.6
Carbon black	178	190	181	249	−6.0
Chlorine	1542	1592	1664	1635	−3.1
Hydrochloric acid	187	180	180	164	3.8
Nitric acid	965	1027	919	900	−6.0
Phosphoric acid, 100% P_2O_5	402	470	475	464	−14.4
Sodium chlorate	658	593	503	432	11.0
Sodium hydroxide	1651	1679	1720	1770	−1.7
Sulfuric acid	3311	3560	3805	3437	−7.0
Zinc oxide	31	41	62	44	−24.4
ORGANIC CHEMICALS					
Benzene	765	670	695	720	14.3
Butadiene	192	175	182	167	9.8
Butylene	176	151	148	156	16.7
Ethylene	2425	2317	2346	2140	4.7
Formaldehyde	106	112	123	122	−4.8
Methanol	1884	2015	2101	1627	−6.5
Propylene	766	719	672	628	6.6
Toluene	427	397	417	396	7.6
Urea	2490	2402	2372	2142	3.7
Xylenes	514	432	399	345	18.8
PLASTICS					
Polyesters, unsaturated	36	37	43	47	−1.3
Polyethylene, high density	364	303	311	269	20.4
Polyethylene, low density	1167	1039	1105	1021	12.3
Polystyrene[a]	215	196	216	197	9.4

a Includes acrylonitrile-butadiene-styrene resins. Source: Statistics Canada

SHIPMENTS: Chemical shipments were weak last year, particularly for inorganics

$ Millions (U.S.)	1990	1989	1988	1987	1986	1985	Change 1989–90[a]
All manufacturing	$252,188	$256,099	$234,446	$203,013	$182,154	$182,526	−3%
Chemicals and chemical products	19,650	19,471	17,808	15,020	13,401	13,409	−1
Industrial chemicals, inorganic	1,998	2,064	1,949	1,790	1,570	1,605	−5
Industrial chemicals, organic	4,589	4,446	4,869	3,676	3,128	3,456	2
Plastics and synthetic resins	2,648	2,547	2,034	1,681	1,488	1,445	3
Pharmaceuticals and medicinals	3,161	3,022	2,528	2,121	1,790	1,637	3
Adhesives	178	177	168	150	136	95	−1
Paint and varnish	1,265	1,313	1,220	1,061	894	885	−5
Soaps and cleansers	1,413	1,401	1,239	1,111	1,084	1,002	−1
Toilet preparations	957	994	863	759	679	644	−5
Printing ink	216	238	208	182	192	177	−11
Synthetic fibers	907	853	791	700	610	572	5
Plastic products	4,975	5,175	4,401	3,686	3,149	2,834	−5

a In Canadian dollars. **Source:** Statistics Canada

CHEMICAL IMPORTS: Post a slight gain

$ Millions (U.S.)	1990	1989	1988	1987
Inorganic chemicals	$1122	$1190	$ 910	$ 396
Organic chemicals	1781	1646	1559	1270
Fertilizers and fertilizer materials	189	156	197	158
Synthetic and reclaimed rubber	241	232	228	202
Plastic materials	1299	1238	1094	831
Plastic film and sheet	435	427	392	372
Other plastic shapes and forms	421	425	430	261
Dyes, except dyeing intermediates	93	96	86	71
Pigments, lakes, and toners	115	117	115	115
Paints and related products	254	233	195	176
Other chemical products	1148	1155	951	857
TOTAL	**$7096**	**$6878**	**$6158**	**$4708**
Imports from U.S.	**$5335**	**$5060**	**$4330**	**$3609**
U.S. share	**75.2%**	**74%**	**70%**	**77%**

Source: Statistics Canada

CHEMICAL EXPORTS: Recover nicely

$ Millions (U.S.)	1990	1989	1988	1987
Chemical elements	$ 179	$ 171	$ 198	$ 167
Other inorganic chemicals	1045	1112	1145	908
Organic chemicals	1702	1542	1528	1029
Fertilizers and fertilizer materials	1422	1237	1351	960
Synthetic rubber and plastic materials	1290	1176	1276	859
Plastics, basic shapes and forms	473	404	383	380
Other chemical products	517	423	380	338
TOTAL	**$6628**	**$6063**	**$6262**	**$4639**
Exports to U.S.	**$4604**	**$4026**	**$3927**	**$2938**
U.S. share	**69.5%**	**66%**	**63%**	**63%**

Source: Statistics Canada

TRADE BALANCE: Back to a surplus . . .

$ Billions (U.S.)	1990	1989	1988	1987	1986
Total exports	$120.9	$113.0	$109.3	$91.9	$83.9
Total imports	116.5	114.1	107.0	87.9	81.3
Trade balance	4.4	−1.1	2.3	4.0	2.5

. . . as chemical trade deficit narrows

$ Millions (U.S.)	1990	1989	1988	1987	1986
Chemical exports	$ 6628	$ 6063	$ 6262	$4639	$ 3961
Chemical imports	7096	6878	6158	4708	4200
Chemical trade balance	−468	−815	−104	−69	−239

Source: Statistics Canada

PRICES: Many chemical prices drop

Price index, 1986 = 100	1990	1989	1988	Change 1989–90
All commodities	109.7	109.4	107.2	0.3%
Chemicals and chemical products	113.8	116.8	115.3	−2.6
Inorganic industrial chemicals	103.8	105.8	102.6	−1.9
Sulfuric acid	111.1	108.6	106.8	2.3
Chlorine	93.0	101.4	101.7	−8.3
Ammonia	78.4	84.3	88.7	−7.0
Organic industrial chemicals	118.3	135.0	135.2	−12.4
Benzene-toluene-xylene	126.0	125.5	98.3	0.4
Olefins	133.1	161.2	158.3	−17.4
Synthetic resins	111.3	123.0	130.8	−9.5
Polyethylene[a]	115.7	134.9	151.7	−14.2
Polystyrene	127.6	140.7	155.9	−9.3
Thermosets	119.7	125.9	121.5	−4.9
Synthetic fibers	106.6	105.5	103.4	1.0
Agricultural chemicals	106.9	102.4	101.3	4.4
Mixed fertilizers	104.7	110.8	111.0	−5.5
Pharmaceuticals	125.2	119.0	114.0	5.2
Paint and varnish	114.5	111.1	105.3	3.1
Soaps and cleaners	116.0	111.9	107.3	3.7
Toilet preparations	112.9	112.9	109.5	0.0
Pigments, lakes, and toners	106.7	105.8	106.1	0.9
Inks	103.1	101.5	100.9	1.6

a Includes both high- and low-density polyethylene. **Source:** Statistics Canada

6 Foreign Chemical Industries — Eastern Europe

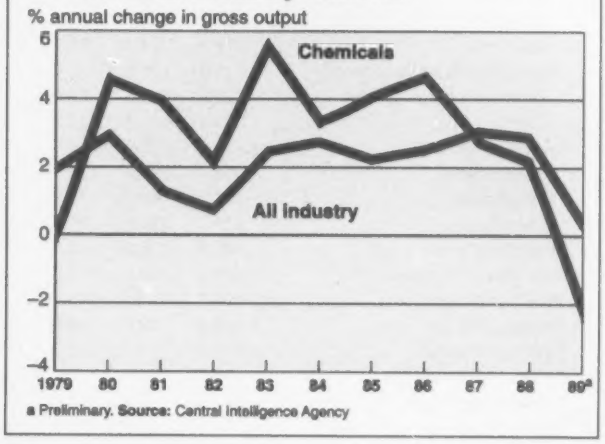
In 1990, industrial production plummeted 18% in East Europe and 1.2% in the Soviet Union—the worst performance in more than four decades—as centrally planned command systems collapsed much faster than market elements could be introduced. Chemicals did worse than industry overall: Output sank 26% in Romania and Bulgaria, 25% in Poland, and 9% in Czechoslovakia. The malaise continues, with Soviet industrial output down 5% in this year's first quarter, fertilizer output down 8%, sulfuric acid 9%, and plastics 5%.

MAN-MADE FIBERS: Down substantially for both cellulosic and noncellulosic fibers

Production, thousands of metric tons	1990	1989	1988	1987	Change 1989–90
NONCELLULOSIC FIBERS					
Bulgaria	na	61	67	61	—
Czechoslovakia	143	148	147	142	−3%
Hungary	26	32	33	30	−19
Poland	113	169	168	162	−33
Romania	138	170	189	184	−19
U.S.S.R.	na	973	954	904	—
TOTAL	na	1745	1736	1644	—
CELLULOSIC FIBERS					
Bulgaria	na	5	5	33	—
Czechoslovakia	57	60	58	55	−6%
Hungary	4	4	4	4	0
Poland	36	69	77	76	−48
Romania	na	103	108	103	—
U.S.S.R.	na	584	601	613	—
TOTAL	na	970	995	1029	—

na = not available. **Source:** PlanEcon Inc.

Soviet chemical output declined in 1989 as that of all industry faltered



a Preliminary. **Source:** Central Intelligence Agency

PRODUCTION GROWTH: Chemicals, like all industry, faced major drop in 1990

% annual change in gross output	1990	1989	1988	1987	1986
U.S.S.R. and East Europe[a]					
All industry	−6.2%	1.3%	3.8%	3.6%	4.4%
Bulgaria					
All industry	−14.1	2.2	5.1	4.2	4.0
Chemicals[b]	−25.5	3.8	5.8	5.1	4.9
Czechoslovakia					
All industry	−3.7	0.8	2.1	2.5	3.2
Chemicals[b]	−9.1	0.7	2.1	3.2	4.0
Hungary					
All industry	−4.5	−2.5	−0.3	3.5	1.9
Chemicals[b]	−5.4	−3.1	1.3	5.8	1.1
Poland					
All industry	−23.3[c]	−0.5	5.3	3.4	4.7
Chemicals	−24.7[c]	2.6	6.4	4.3	4.2
Romania					
All industry	−19.8	−2.1	3.1	2.4	7.3
Chemicals	−26.0	−3.1	3.2	−3.8	8.3
U.S.S.R.					
All industry[d]	−1.2	1.7	3.9	3.8	4.4
Chemicals[d]	−1.0	1.4	3.8	4.4	6.3
All industry[e]	na	0.2[f]	2.9	3.1	2.5
Chemicals[e]	na	−2.5[f]	2.2	2.7	4.8

a Includes East Germany. b Includes rubber industry. c Industrial sales of socialized sector. d Figures based on official Soviet statistics. e Figures based on Central Intelligence Agency estimates, giving lower results because of postulated upward bias in official figures. f Preliminary figure. na = not available. **Sources:** United Nations Economic Commission for Europe and state central statistical bureaus, Central Intelligence Agency, PlanEcon Inc.

AGRICULTURAL CHEMICALS: Fertilizer supplies continue to fall in Soviet Union

Thousands of metric tons	1990	1989	1988	1987	1986
Bulgaria					
Fertilizer supply[a]	na	na	781	745	808
Pesticide supply[b]	na	na	26.3	28.5	36.5
Czechoslovakia					
Fertilizer supply[a,c]	na	1,565	1,594	1,562	1,702
Hungary					
Fertilizer supply[a]	na	1,302	1,418	1,373	1,383
Poland					
Fertilizer supply[a,c]	na	3,625	3,277	3,583	3,413
Pesticide supply[b]	na	21.0	23.4	18.4	14.5
Romania					
Fertilizer supply[a]	na	1,194	1,426	na	1,386
U.S.S.R.					
Fertilizer supply[a]	21,500	24,482	27,196	27,412	26,514
Nitrogen[a]	8,900[d]	9,918	11,587	11,787	11,475
Phosphate[a,e]	7,000[d]	8,175	8,556	8,564	8,354
Potassium[a]	5,600[d]	6,381	7,044	7,052	6,677

a Nutrient content basis, as N, P_2O_5, or K_2O. b On basis of active substance. c For year ending June 30. d Estimated value. e Includes ground phosphate rock. na = not available. **Sources:** Department of Agriculture, Central Intelligence Agency, official national statistics from state central statistical bureaus

PRODUCTION: Further declines for most countries' chemical products in 1990

Thousands of metric tons	1990	1989	1988	1987	1986
U.S.S.R.					
Sulfuric acid	27,300[a]	28,276	29,372	28,531	27,847
Mineral fertilizers[b]	31,700[a]	34,254	37,138	36,334	34,737
Nitrogen[b]	13,500[a]	14,355	15,815	15,743	15,221
Phosphate[b,c]	8,800[a]	9,657	10,013	9,693	9,279
Potassium[b]	9,400[a]	10,233	11,300	10,888	10,228
Synthetic ammonia[d]	na	19,422	20,330	19,931	19,590
Plastics[e]	5,500[a]	5,763	5,675	5,488	5,345
Sodium hydroxide	3,000[a]	3,185	3,323	3,288	3,229
Ethylene	na	3,137	3,175	2,977	2,799
Methanol	na	3,331	3,211	3,284	3,219
Synthetic rubber[f]	na	2,400	2,435	2,366	2,320
Pesticides[g]	na	276	317	327	332
BULGARIA					
Sulfuric acid	na	846	840	688	807
Mineral fertilizers[b]	na	724	588	571	580
Nitrogen[b]	na	555	588	443	448
Phosphate[b]	na	169	179	128	132
Synthetic ammonia[d]	na	1,326	1,342	1,070	1,091
Plastics	231	328	363	322	420
Sodium hydroxide	na	118	124	104	138
Synthetic rubber	na	25	25	24	25
Pesticides[g]	na	19	18	15	15
CZECHOSLOVAKIA					
Sulfuric acid	1,033	1,142	1,249	1,264	1,292
Mineral fertilizers[b]	877	1,008	1,025	984	1,041
Nitrogen[b]	514	604	596	596	614
Phosphate[b,c]	257	296	313	277	307
Potassium[b,g]	106	108	116	111	120
Synthetic ammonia[d]	na	797	774	781	765
Plastics	1,174	1,186	1,192	1,150	1,140
Sodium hydroxide	335	337	337	332	335
Synthetic rubber	70	75	79	76	76
Pesticides[g]	17	18	19	18	20
HUNGARY					
Sulfuric acid	244	482	512	573	540
Mineral fertilizers[b]	693	903	921	1,067	1,040
Nitrogen[b]	419	587	574	667	655
Phosphate[b]	94	215	238	283	267
Potassium[b,h]	180	101	136	117	118
Synthetic ammonia[d]	576[f]	681	691	784	763
Plastics	603	638	590	545	426
Sodium hydroxide[i]	193	204	202	201	202
Ethylene	234	262	264	270	269
Pesticides[g]	24	38	35	38	35
POLAND					
Sulfuric acid	1850[f]	3114	3154	3149	2966
Mineral fertilizers[b]	1854	2725	2719	2622	2526
Nitrogen[b]	1302	1643	1622	1543	1445
Phosphate[b]	467	945	962	942	948
Potassium[b,h]	85	137	134	137	133
Synthetic ammonia[d]	1768[f]	1941	1923	1791	1747
Plastics	624	721	723	641	632
Sodium hydroxide	397	434	444	422	427
Ethylene	308	322	328	276	279
Methanol	155	162	168	172	169
Synthetic rubber	103	125	128	117	116
Pesticides[g]	na	11	11	9	8
ROMANIA					
Sulfuric acid	1112	1687	1825	1693	1971
Mineral fertilizers[b]	1742	2805	2994	2897	3278
Nitrogen[b]	1225[f]	2035	2130	2096	2315
Phosphate[b]	425[f]	648	725	665	849
Synthetic ammonia[d]	1974[f]	2744	2804	2784	3037
Plastics	520[f]	640	653	638	664
Sodium hydroxide	556	763	821	817	846
Ethylene	243	332	335	319	312
Synthetic rubber	102	149	161	152	173
Pesticides[g]	21[f]	34	39	39	47

a Approximate figures. b Nutrient content basis, as N, P_2O_5, or K_2O. c Including production of ground phosphate rock for direct applications and phosphate animal feeds. d Nitrogen content. e Including resins for man-made fibers. f Estimated. g On basis of active substance. h Imported potash added to domestically produced nitrogen and phosphate to form multinutrient fertilizer. i Including regenerated NaOH. na = not available. **Sources:** Central Intelligence Agency, Department of Agriculture, PlanEcon Inc., official national statistics from state central statistical bureaus

SOVIET FOREIGN TRADE: Rapidly rising trade deficit also affects chemical trade

$ Millions	1990[a]	1989[a]	1988	1987	1986	1985	1984	1983	1982	1981	1980
Exports[b]	$ 98,172	$109,299	$110,740	$107,664	$ 97,053	$87,196	$91,495	$91,652	$87,168	$ 79,380	$ 76,437
Imports[b]	114,372	114,698	107,316	95,971	88,874	83,315	80,409	80,445	77,846	73,194	68,473
Trade balance	−16,200	−5,399	3,424	11,693	8,179	3,881	11,086	11,207	9,322	6,186	7,964
Chemical exports[b]	na	3,592	3,559	2,979	2,770	2,837	2,707	2,307	2,203	2,275	2,025
Chemical imports[b]	na	5,404	4,924	4,516	3,990	3,744	3,256	3,216	3,028	3,211	3,275
Chemical trade balance	na	−1,812	−1,365	1,537	−1,220	−907	−549	−909	−825	−1,651	−1,250

a Preliminary values. b Free on board. na = not available. **Sources:** Central Intelligence Agency, U.S.–U.S.S.R. Trade & Economic Council, based on official Soviet statistics and exchange rates for the Soviet foreign exchange ruble

6 Foreign Chemical Industries — Pacific Basin

SOUTH KOREA

INDUSTRY TRENDS: Chemicals up strongly

Index, 1985 = 100	1990	1989	1988	1987	Change 1989–90
Chemicals, petroleum, coal, rubber, and plastic products					
Production	172.9	154.8	150.7	127.6	12%
Shipments	174.4	152.7	146.8	124.5	14
Inventories	176.1	155.4	128.6	114.2	13
Industrial chemicals					
Production	188.6	156.6	149.3	128.0	20
Shipments	184.7	151.6	146.1	128.2	22
Inventories	183.0	164.6	117.6	107.1	11
Other chemical products					
Production	205.5	183.0	171.3	133.1	12
Shipments	209.4	186.5	170.0	135.6	12
Inventories	234.6	195.5	159.5	121.7	20
Rubber products					
Production	144.7	128.1	151.1	140.1	13
Shipments	143.8	128.1	150.9	139.2	12
Inventories	122.3	123.1	131.2	119.4	−1
Plastic products					
Production	158.9	156.9	159.5	138.1	1
Shipments	151.2	145.5	148.3	133.4	4
Inventories	225.9	193.3	148.3	143.5	17
All manufacturing					
Production	186.5	171.3	166.3	146.6	9
Shipments	191.0	171.6	164.6	145.1	11
Inventories	190.7	162.1	137.6	120.7	18

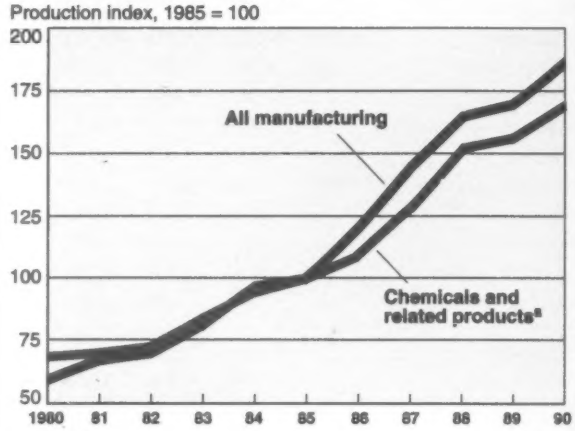
Source: Korean National Statistical Office

FOREIGN TRADE: Imports far outpace exports

$ Millions	1990	1989	1988	1987
Exports[a]	$ 65,016	$ 62,377	$ 60,696	$ 47,281
Imports[b]	69,844	61,465	51,811	41,020
Trade balance	−4,828	912	8,886	6,261
Chemical exports[a,c]	2,511	2,050	1,879	1,321
Chemical imports[b,c]	7,434	7,158	6,282	4,595
Chemical trade balance	−4,922	−5,108	−4,404	−3,274

a Free on board. b Includes cost, insurance, freight. c Includes chemicals and related products. **Source:** Korean Office of Customs Administration

Growth picks up in 1990 for South Korean chemicals production



a Includes petroleum, coal, rubber, and plastic products.
Source: Korean National Statistical Office

PRODUCTION: Organics post biggest gains

Thousands of metric tons	1990	1989	1988	1987	Change 1989–90
Complex fertilizers	1926	1985	2076	2026	−3%
Ethylene	1054	663	609	576	59
Urea fertilizers	883	888	1000	911	0
Polyethylene	786	637	572	469	23
Polyester fibers	730	654	593	496	12
Propylene	608	375	351	328	62
Polypropylene	574	530	518	348	8
Polyvinyl chloride	526	464	455	451	14
Polystyrene	507	434	341	304	17
Benzene	381	305	308	339	25
Synthetic detergents	342	297	278	214	15
Sodium hydroxide	328	295	311	262	11

Source: Korean National Statistical Office

AUSTRALIA

PRODUCTION: Plastics ease downward

Thousands of metric tons, unless otherwise noted	1990[a]	1989[a]	1988[a]	1987[a]	Change 1989–90
Chemicals					
Superphosphate[b]	2659	na[c]	na[c]	na[c]	—
Sulfuric acid, 100%	1464	1904	1818	1678	−23%
Ammonium sulfate	214	165	179	165	30
Acetylene, thousand cubic meters	2654	na[c]	na[c]	na[c]	—
Plastics and resins	975	986	990	904	−1
Detergents and soap	319	na[c]	na[c]	na[c]	—
Flexible plastic film, sheets[d]	183	na[c]	na[c]	na[c]	—
Polyethylene[e]	141	na[c]	na[c]	na[c]	—
Polypropylene	19	na[c]	na[c]	na[c]	—

a Year ending June 30. b Includes double and triple superphosphates expressed in terms of single phosphate (9% P equivalent). c Not available prior to July 1989 because of revised commodity classification. d Includes flexible plates, sheets, foil, and strip of plastics; excludes self-adhesive, floor, wall, and ceiling coverings, vulcanized fibers, plastic foam, and plastics reinforced, laminated, or supported with other materials. e Low and high density. na = not available. **Source:** Australian Bureau of Statistics

FOREIGN TRADE: Exports growing fastest

$ Millions	1990[a]	1989[a]	1988[a]	1987[a]
Exports[b]	$ 37,817	$ 35,465	$ 29,936	$ 23,745
Imports[c]	39,510	38,404	29,592	24,568
Trade balance	−1,693	−2,939	344	−823
Chemical exports[b]	948	861	650	440
Medicinal products	205	190	149	110
Chemical imports[c]	3,999	4,046	3,119	2,304
Organic chemicals[d]	825	951	806	584
Medicinal products	631	566	472	337
Chemical trade balance	−3,051	−3,185	−2,469	−1,864

Note: Monetary statistics converted from Australian to U.S. dollars on basis of $A1.00 equals: 1987, $0.6636; 1988, $0.7290; 1989, $0.8160; 1990, $0.7697. a Year ending June 30. b Free on board. c Values for customs purposes, free-on-board basis. d Includes organic-inorganic and heterocyclic compounds. **Sources:** Australian Department of Foreign Affairs & Trade, Reserve Bank of Australia

CHINA

PRODUCTION: Big gains for plastics, fibers, and especially soda ash

Thousands of metric tons	1990	1989	1988	1987	Change 1989–90
Synthetic ammonia	21,251	20,675	19,725	19,486	3%
Fertilizer[a]	19,120	18,547	17,670	17,033	3
Sulfuric acid[b]	11,689	11,408	10,981	9,620	2
Sodium hydroxide[b]	3,338	3,211	2,925	2,735	4
Sodium carbonate	3,746	2,983	2,593	2,372	26
Plastics	2,249	1,973	1,552	1,571	14
Man-made fibers	1625	1466	1284	1157	11%
Synthetic detergents	1484	1431	1290	1192	4
Ethylene	1572	1405	1231	839	12
Pesticides	229	224	202	157	2
Pharmaceuticals	172	196	194	154	−12
Synthetic rubber	316	289	251	218	9

a Nutrient content. b 100%. na = not available. **Sources:** State Statistical Bureau of the People's Republic of China, *China Economic News*, Central Intelligence Agency, *China Statistics Monthly*

CHEMICAL IMPORTS: Decline continues in 1990

$ Millions[a]	1990	1989	1988	1987	Change 1989–90
Organic chemicals	$1131	$1405	$1701	$ 998	−20%
Inorganic chemicals	215	469	448	422	−54
Dyeing, tanning, coloring materials	244	226	237	202	8
Medicinal and pharmaceutical products	395	311	384	229	27
Fertilizers[b]	2605	2364	2335	1399	10
Plastic materials, resins, cellulose esters and ethers	1498	2206	3558	1470	−32
TOTAL[c]	$6650	$7556	$9139	$5008	−12%

a Includes cost, insurance, and freight. b Manufactured. c For all chemicals and related products. **Source:** General Administration of Customs of the People's Republic of China

CHEMICAL EXPORTS: Growing strongly

$ Millions[a]	1990	1989	1988	1987	Change 1989–90
Organic chemicals	$ 838	$ 690	$ 575	$ 500	21%
Inorganic chemicals	842	794	762	553	6
Dyeing, tanning, coloring materials	366	288	229	175	27
Medicinal and pharmaceutical products	622	549	468	408	13
Essential oils, perfumes, cleansing materials	319	235	183	136	36
Explosives, pyrotechnic products	211	244	298	183	−13
TOTAL[b]	$3730	$3201	$2897	$2235	16%

a Free on board. b For all chemicals and related products. **Source:** General Administration of Customs of the People's Republic of China

TAIWAN

INDUSTRY TRENDS: Chemicals set the pace

Industrial production indexes, 1986 = 100	1990	1989	1988	1987	Change 1989–90
All manufacturing	117.3	119.3	115.4	111.2	−2%
Chemical materials	119.6	110.3	108.0	103.6	8
Basic chemicals	114.8	102.9	94.4	96.5	12
Petrochemicals	96.0	92.9	98.8	97.1	3
Fertilizers	114.1	111.3	113.4	102.9	3
Synthetic fibers	142.7	126.7	113.5	109.7	13
Plastics and resins	139.1	126.1	122.8	110.6	10
Chemical products	139.8	129.1	125.7	114.8	8

Source: Taiwan Ministry of Economic Affairs

FOREIGN TRADE: Chemical exports up 6%

$ Millions	1990	1989	1988	1987
Exports[a]	$ 67,214	$ 66,201	$ 60,585	$ 53,612
Imports[b]	54,716	52,249	49,656	34,957
Trade balance	12,498	13,952	10,929	18,655
Chemical exports[a,c]	5,711	5,397	4,844	3,741
Chemical imports[b,c]	7,621	7,408	7,051	5,150
Chemical trade balance	−1,910	−2,011	−2,207	−1,409

Note: Statistics converted from NT$ to U.S. dollars on basis of $1.00 equals: 1990, NT$26.9; 1989, NT$26.4; 1988, NT$28.6; 1987, NT$31.8. a Free on board. b Includes cost, insurance, and freight. c Includes chemicals, chemical products and plastic and rubber products. **Sources:** Taiwan Council for Economic Planning & Development, Taiwan Ministry of Finance Department of Statistics, C&EN estimates

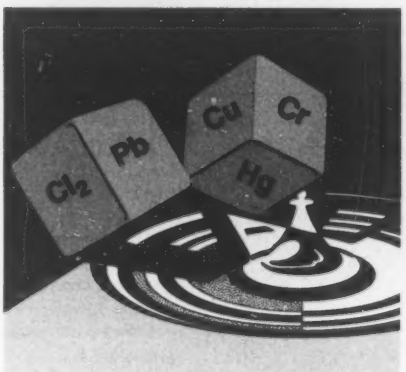
PRODUCTION: Many plastics doing well

Thousands of metric tons, unless otherwise noted	1990	1989	1988	1987	Change 1989–90
Polyester[a]	1290	1193	1100	1076	8%
Polyvinyl chloride	921	805	779	773	14
Terephthalic acid[b]	798	583	495	500	37
Ethylene	776	766	852	823	1
Vinyl chloride	665	662	708	699	0
Sulfuric acid	658	768	664	742	−14
Ammonium sulfate	509	524	484	485	−3
Propylene	398	398	441	442	0
Acrylonitrile-butadiene-styrene	384	311	301	208	23
Oxygen[c]	370	352	350	261	5
Polyethylene[d]	360	344	390	375	5
Styrene	355	301	331	310	18
Calcium superphosphate	354	352	315	342	1
Ammonia, anhydrous	263	246	339	296	7
Xylene	254	239	164	235	6
Paints	239	214	247	229	12
Hydrochloric acid	234	217	255	251	8
Urea	229	237	306	244	−3
Dioctyl lactam	188	179	187	192	5
Ethylene glycol	178	216	197	195	−18

a Filament and fiber. b Pure terephthalic acid. c Millions of cubic meters. d Low and high density. **Source:** Taiwan Council for Economic Planning & Development

Multiple Chemical Sensitivity

Reviewed by **Herbert L. Needleman**



Sensitivity to small doses of chemicals is a serious problem, and developing a sound database to sort it out will take a long time

"Chemical Exposures: Low Levels and High Stakes" by Nicholas A. Ashford and Claudia S. Miller, Van Nostrand Reinhold, 115 Fifth Ave., New York, N.Y., 10003, 1991, 214 pages, **$18.95**

In the closing months of World War II, with Hitler's Wermacht in wholesale retreat across Europe, a series of unusual advertisements by chemical, refrigerator, and automobile manufacturers began to appear in American magazines. These ads hoped to sell nothing; the sponsors' factories were busy supplying the Allied war effort. Their purpose was to refurbish the memories of potential customers for such names as Chevrolet, Norge, and Du Pont, and to prime the pump for the time when consumer goods instead of tanks and warplanes would roll off the production lines.

The prototypical advertisement portrayed a GI in a foxhole visualizing the glittering future (often a gauzy sketch in the upper right-hand corner) that waited for him at home. Gleaming glass skyscrapers laced by sweeping superhighways made up the cities of his vision. He was to have not just a car, but a personal helicopter, air-conditioning, wire recorders, 15-hour coast-to-coast air travel, and plastics! Four decades later, we have achieved almost all of this and much more. And now at the end of the 20th century, the motto "better living through chemistry" has a quaint and ironic ring.

Parallel with our society's simplistic, optimistic view of materialistic progress and the new chemical products that came with it, toxicologists in the 1940s relied almost entirely on the LD_{50} (lethal dose/50%) to test chemical toxicity. This is the measure of what dose kills half the rodents in a given experiment. But important changes in the health sciences began to emerge as the war came to an end. Toxicologists began to reduce their dependence on the LD_{50}. Slowly, and with no little resistance, attention shifted to subtler outcomes: growth rates, biochemical indexes, and even behavior. The threshold for toxicity dropped, the definition of specific toxic syndromes broadened, the number of individuals defined as affected increased, and the allowable exposure levels for many substances were reduced.

These more sensitive measures led some toxicologists and environmental scientists to realize that there were more affected individuals at lesser exposures than we had previously reckoned. We began to get hints that each synthetic process bears its own risk or cost and that these clever synthetic molecules eventually find receptors or targets in human beings.

Blue-collar workers are among the first to be affected. They encounter the highest doses in their workplaces, but they are not the only individuals to be exposed. Sealing a building allows biologically active vapors to pile up, and these affect white-collar employees as well. Glues, caulks, plasticizers, and pesticides can be irritating to almost everybody and are downright sickening to some.

A growing number of people display recurring symptoms in many organ systems that appear related to very small doses of a number of chemicals. Perhaps 15% of individuals experience increased sensitivity to multiple chemicals and the number may be growing.

This is a serious problem. And it is vexed, as are most serious problems, by at least three competing interest groups, each with a different viewpoint. The orthodoxy is represented by clinical allergists, and the heterodoxy by clinical ecologists, a relatively new but large group. Clinical ecology developed in reaction to the refractory approach of orthodox allergists to any "sensitivity" phenomenon not accompanied by evidence of humoral allergy exhibited in a positive serum or skin test. Clinical ecologists are a growing and vocal group with about 2000 practitioners. The third interest group is psychiatrists, who often are asked to see patients with obscure and ill-characterized complaints. Psychiatrists have tended to view this turmoil from Olympian heights and assign the label of malingerer, hysteric, or depressive to the victim.

Into this intellectual-tag team match come Nicholas A. Ashford and Claudia S. Miller with their book "Chemical Exposures: Low Levels and High Stakes." It takes no small amount of courage to enter a field as roiled as this, and the authors are to be commended for their attempt to bring the light of scholarship and the scalpel of criticism to bear. They are partially successful. Even though this is a new field, the relevant literature is huge, and this